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U.S. Army
Chemical Materials Agency
Program Manager for the Elimination of Chemical Weapons

Product Manager for Non-Stockpile Chemical Materiel

Plan for Destruction of Recovered Chemical Warfare Materiel at Dugway Proving Ground, Utah Using the Explosive Destruction System

Final
Revision 2

March 2004

EXECUTIVE SUMMARY

The Program Manager for the Elimination of Chemical Weapons (PM ECW) is responsible for destroying all United States chemical warfare materiel. The Product Manager for Non-Stockpile Chemical Materiel (PMNSCM) is responsible for destroying non-stockpile chemical materiel, including recovered chemical warfare materiel (CWM).

This Destruction Plan describes procedures for destroying and treating recovered chemical warfare materiel at Dugway Proving Ground (DPG) using the Explosive Destruction System (EDS). The PMNSCM, at the request of DPG, has decided to dispose of 15 munitions currently stored at DPG. Seven Department of Transportation (DOT) cylinders will also be disposed of using the EDS. The 15 munitions currently are overpacked in propelling charge cans (PCCs) and the 7 DOT cylinders are currently overpacked in multiple round containers (MRCs). All items are stored in Igloo G at DPG. There is also a 105mm projectile filled with lewisite stored at DPG. If, while the EDS is at DPG, approvals are obtained to treat lewisite in the EDS, then the 105mm projectile will be treated.

This Destruction Plan is based on procedures in the EDS Standing Operating Procedures (SOPs) and provides a description of the operations and sampling strategy for this operation. The procedures described in this Plan will ensure the operation is conducted in a safe, secure, and environmentally sound manner.

DPG is the lead for public outreach activities. DPG will coordinate with the PMNSCM Public Outreach and Information Office to exchange information.

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SECTION 1
INTRODUCTION

The Product Manager for Non-Stockpile Chemical Materiel (PMNSCM) will use the Explosive Destruction System (EDS) to safely destroy 15 recovered munitions and 7 Department of Transportation (DOT) cylinders at Dugway Proving Ground (DPG), Utah.

A system Hazard Analysis (HA) has been prepared for the EDS (PMCD, 2002). In addition, a Job HA has been prepared for each Standing Operating Procedure (SOP) used for EDS operation. Annex A to this Destruction Plan is a plan-specific HA covering hazards associated with EDS operations and hazards to the EDS system from incidents that might occur at DPG. The HA in annex A was prepared in accordance with the *System Safety Management Plan for the Non-Stockpile Chemical Materiel Product* (PMCD, 2001b). An HA covering the hazards to explosive ordnance personnel and equipment associated with movement and handling of an item before it is placed in the EDS has been prepared in accordance with Army Regulation (AR) 385-61 and is included in annex G of this Destruction Plan.

1.1 Purpose

This Destruction Plan provides a scope of effort for using the EDS at DPG to safely destroy recovered chemical warfare materiel (CWM) and treat the chemical agent fill.

1.2 Approval Process

Plans for use of the EDS at DPG will be submitted to the State of Utah for approval before destruction begins. In addition, PMNSCM will coordinate with the U.S. Department of Health and Human Services (DHHS) and DPG will coordinate with the Utah Department of Environmental Quality (UDEQ) as well as the Department of Army Safety and the Department of Defense Explosives Safety Board (DDESB).

Concurrence/approval by DHHS, UDEQ, and the other agencies will be obtained before implementation of this Destruction Plan.

1.3 Historical Precedence for Destruction

Until recently, the only method available for destruction of an armed and fuzed chemical agent-filled munition was open detonation where a quantity of explosives sufficient to destroy the munition and its chemical fill were placed around the recovered munition and detonated. The detonation was designed to produce sufficient heat to destroy explosives and chemical agent inside the recovered munition.

Concerns over collateral damage due to noise, blast, and fragmentation caused by open detonation led the Army to develop the EDS. The EDS is an explosion and vapor containment chamber into which the munition is placed for destruction. Unlike open detonation, the EDS does not use explosives to destroy the chemical agent. The EDS uses explosives to open the munition, expose the chemical agent, and destroy the fuze and burster. The chemical agent then is treated using chemical neutralization.

The EDS has been extensively tested on munitions similar to the ones that will be destroyed using this plan. To date, the EDS technology has been used to safely and successfully destroy 98 items. Table 1-1 provides a summary of these destructions.

1.4 Site Description

The items are currently stored in Igloo G at DPG. Figure 1-1 shows the location of DPG and figure 1-2 shows the location of Igloo G and the EDS site. Figure 1-3 shows the layout of the EDS site. The EDS will be set up at a suitable location near Igloo G to minimize the distance the items must be moved, while maintaining the prescribed explosive safety areas around both Igloo G and the EDS.

Table 1-1. EDS Phase 1 Operations History

EDS System: Items Destroyed	
EDS Phase 1 Unit 1:	
53 Items (projectiles, mortars, bomblets, cylinders, etc.)	
EDS Phase 1 Units 2 and 3 at Aberdeen Proving Ground, Maryland:	
1 Phosgene-filled Bottle	7 Water-filled 4.2-inch SETH Mortars
2 Mustard-filled Bottles	1 Water-filled Bottle
1 Mustard-filled Stokes Mortar	1 Sarin-filled Bomblet
1 Phosgene-filled 4-inch Mortar	15 Mustard-filled 75mm Projectiles
1 Mustard-filled 8-inch Livens Projectile	
EDS Phase 1 Unit 2 at Spring Valley, District of Columbia:	
15 Mustard-filled 75mm Projectiles	

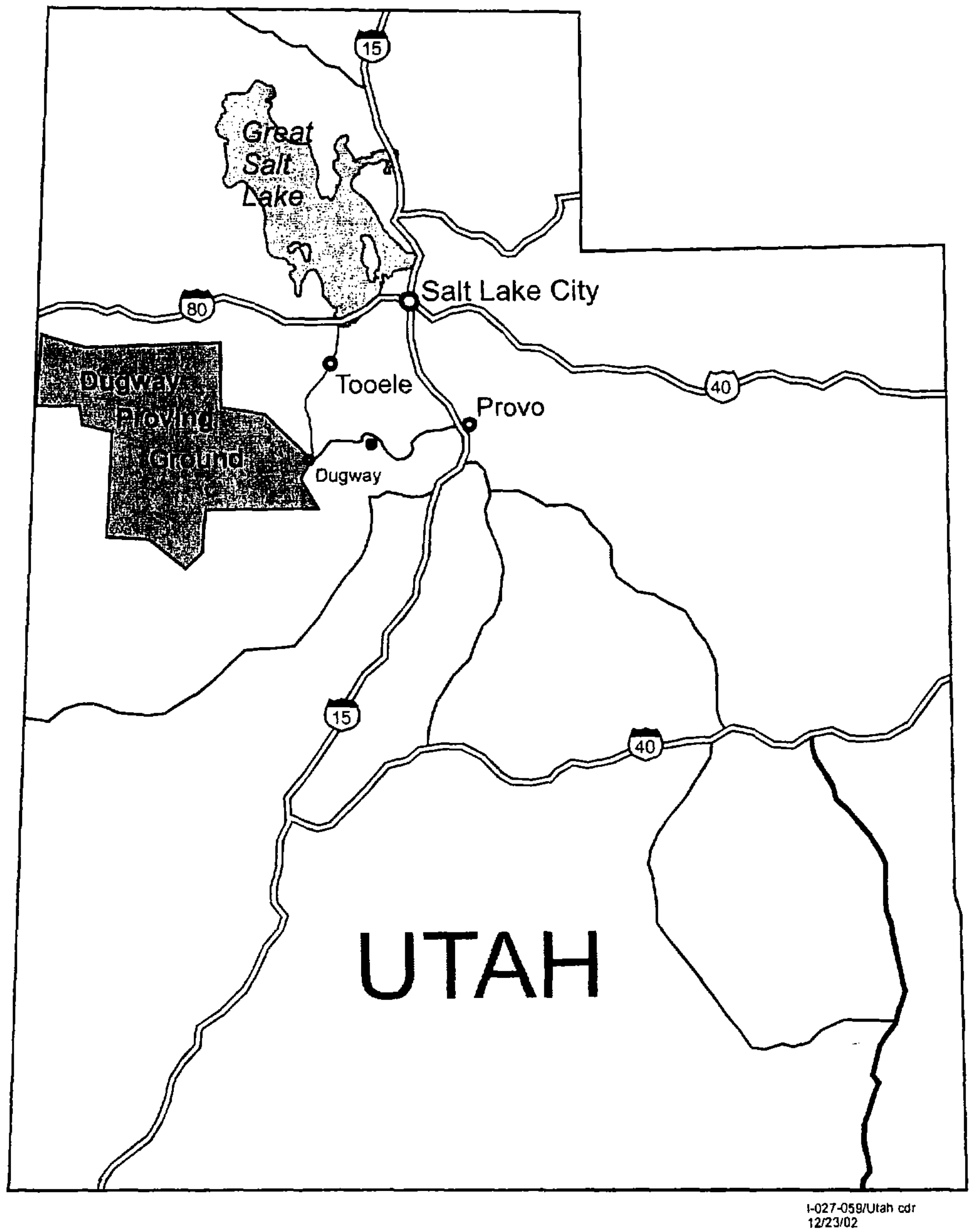

Figure 1-1. Location of DPG

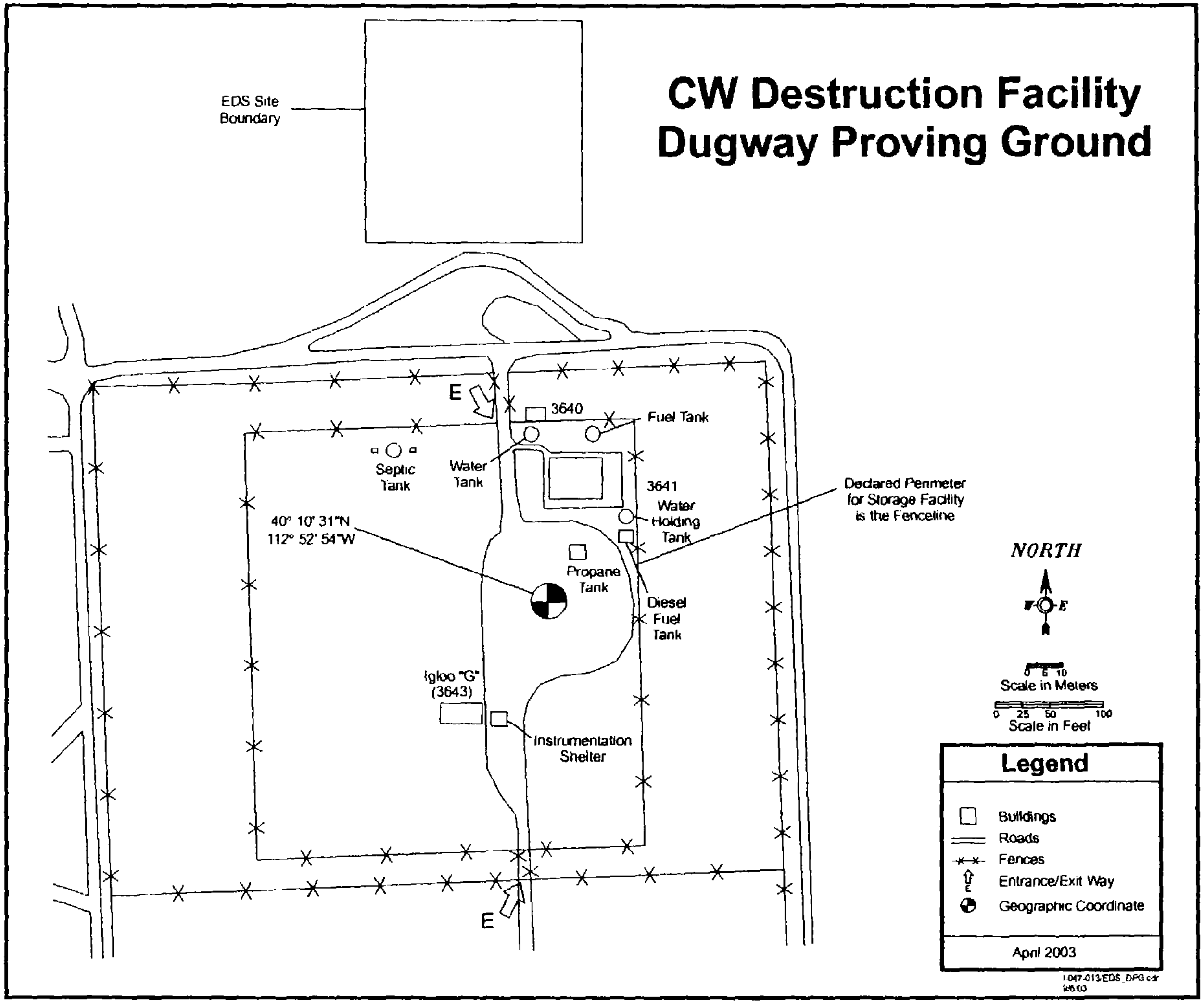

Figure 1-2. Location of Igloo G and the EDS Site at DPG

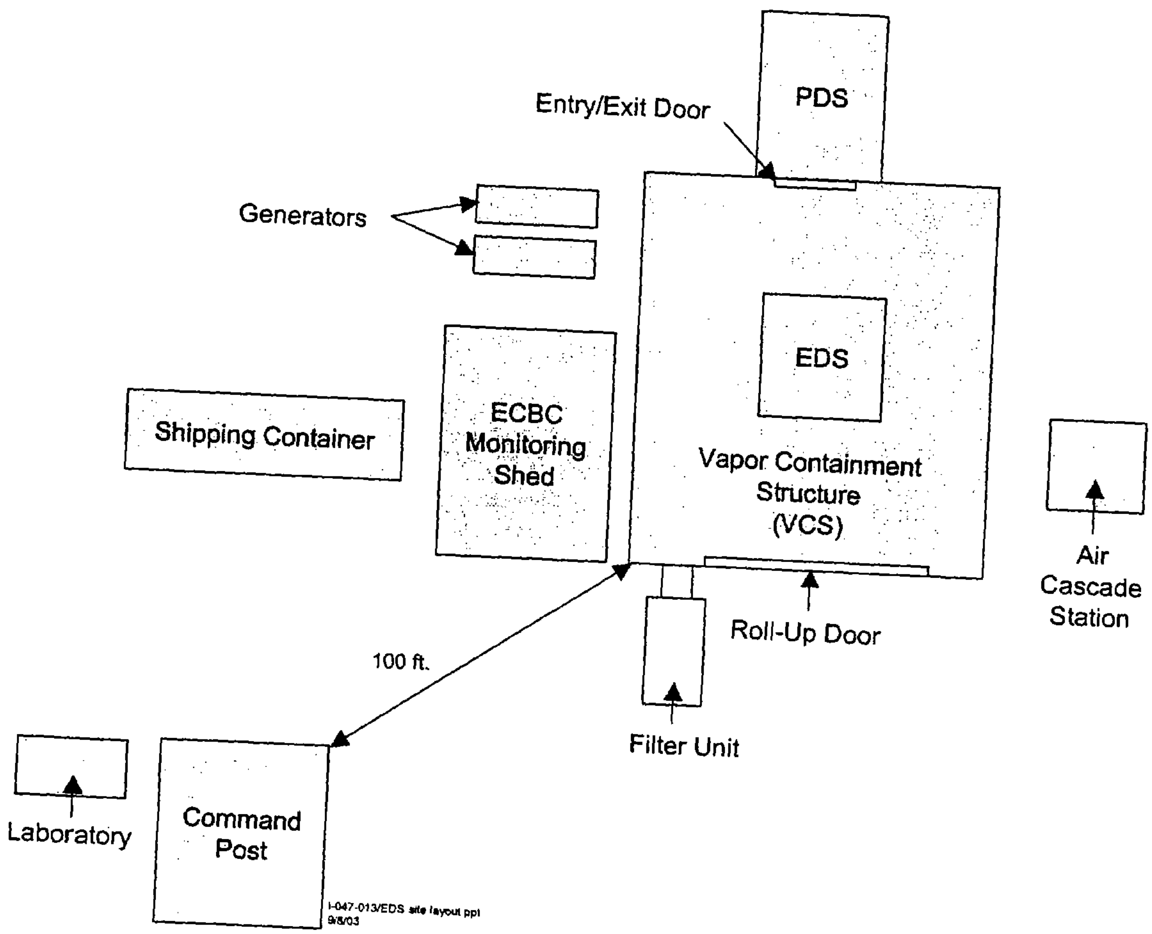

Figure 1-3. Generic Layout of EDS Site at DPG

1.5 Chemical Weapons Convention (CWC) Compliance

The United States is obligated to notify the Organisation for the Prohibition of Chemical Weapons (OPCW), Technical Secretariat (TS), whenever declared chemical weapons are scheduled for destruction. Some of the items planned for destruction at DPG are declared chemical weapons. Therefore these items will be destroyed in full compliance and with verification by the CWC. Annex L illustrates an EDS scenario from the CWC perspective with the CWC checkpoints that will be followed at DPG. EDS personnel must be familiar with these requirements and incorporate them into their operations.

1.6 Emergency Planning and Contingency Operations

The site-specific Heath and Safety Plan (HASP) located in Annex I of this Destruction Plan contains information on support operations such as medical support and firefighting. The HASP also describes actions to be taken to protect workers and the public in the event of chemical agent accident or incident.

1.7 Air Monitoring

EDS monitoring will be performed in accordance with the EDS Site-Specific Monitoring Plan, annex F to this Destruction Plan. Edgewood Chemical Biological Center (ECBC) will provide personnel and equipment for air monitoring of distilled mustard (HD) and sarin (GB). (Mustard-T mixture [HT] will be monitored as HD.) Air monitoring objectives include ensuring that worker and public safety and health are maintained by providing adequate environmental monitoring as specified in AR 385-61.

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SECTION 2
SYSTEM DESTRUCTION

2.1 Items to be Destroyed

The munitions to be destroyed are listed in table 2-1, munitions, and table 2-2, DOT cylinders. The munitions include 4.2-inch mortars, a 105mm projectile, an M139 bomblet half, and an M125 bomblet. The munitions have been assigned identification numbers, also listed in table 2-1. Annex B contains background information from the *Old Chemical Weapons Reference Guide* (SciTec, 1998) on the types of munitions that will be destroyed. This information is provided for readers who may not be familiar with the specifications for these munitions.

In addition to the munitions described in table 2-1, there are seven DOT cylinders (table 2-2) filled with either HD or HT that will be treated using the EDS.

Destruction of the munitions and DOT cylinders will be conducted in campaigns based on chemical fill.

2.2 Fill Materiel

The Materiel Assessment Review Board (MARB) has assessed the status of the explosives and chemical agent fills of each munition that will be destroyed. Table 2-1 contains results of the MARB determination. The fill materiel of the munitions include blister agent mustard (H and HD) and the nerve agent GB. The DOT cylinders are filled with HD and HT.

2.3 EDS System Description

Destruction operations at DPG will be performed with the EDS Phase 1 Unit 3 (P1U3). For the rest of the document, the system will be referred to as the EDS.

Table 2-1. Summary of MARB Data for Munitions to be Destroyed

Item	MARB Number	Munition	Explosive Components	Fill Materiel	Assumed Fill Weight (kg)[a]
1	DPG-94-005	M139 bomblet half	None	GB	0.295 (for 1 bomblet half)
2	DPG-94-006	M60 105mm	No fuze, burster present	HD	1.44
3	DPG-94-007	M125 bomblet	No fuze	GB	1.18
4	DPG-94-012	4.2-inch mortar	No fuze, burster present	HD	1.35 (50% fill)
5	DPG-94-013	4.2-inch mortar	No fuze, burster present	HD	2.7
6	DPG-94-016	4.2-inch mortar	No fuze, no burster, primer present	HD	2.7
7	DPG-94-017	4.2-inch mortar	No fuze, burster present	HD	2.7
8	DPG-94-018	4.2-inch mortar	No fuze, burster present	HD	2.7
9	DPG-94-020	4.2-inch mortar	No fuze, burster present	HD	2.7
10	DPG-94-022	4.2-inch mortar	No fuze	HD	2.7
11	DPG-94-023	4.2-inch mortar	No fuze	HD	0.8 (30% fill)
12	DPG-94-025	4.2-inch mortar	No fuze	HD	1.4 (50% fill)
13	DPG-94-026	4.2-inch mortar	Unarmed, burster present	HD	2.7
14	DPG-94-031	4.2-inch mortar	Fuze and burster present	HD	2.7
15	DPG-94-032	4.2-inch mortar	Burster present	HD	2.7

Notes:

[a] Fill weights are based on the Old Chemical Weapons Reference Guide (SciTech, 1998) and information about the percent fill recorded in the MARB report.

DPG = Dugway Proving Ground
GB = sarin
HD = distilled mustard agent
kg = kilogram
MARB = Materiel Assessment Review Board
mm = millimeter

Table 2-2. DOT Cylinders to be Treated in the EDS

Identification Number	Fill Material	Agent Fill Volume (mL)
98501C	HD	323
98502C	HD	498
98503C	HD	498
98504C	HD	497
98505C	HD	498
98506C	HD	193
98508C	HT	44

Notes:

HD = distilled mustard
HT = mustard-T mixture
mL = milliliter

The EDS is a trailer-mounted system designed to safely access and treat the chemical agent inside an explosively configured munition while at the same time destroying the explosive components of the munition. The main subsystem of the EDS is a stainless steel (SS) pressure chamber where the explosives are detonated and the chemical fill is treated. Other subsystems include a system for collecting liquid and vapor samples and plumbing for addition of neutralization reagent and draining of treatment waste. Figure 2-1 depicts the EDS and identifies the location of the various subsystems.

2.3.1 Hardware. The EDS is comprised of the following subsystems:

- Trailer Subsystem
- Containment Vessel Subsystem
- Hydraulic Nut Subsystem
- Rotary Agitation Subsystem
- Reagent Supply Subsystem
- Waste Transfer Subsystem
- Electrical Subsystem
- Explosive Opening Subsystem.

2.3.1.1 Trailer Subsystem. The primary components of the EDS are mounted on an 8-1/2 by 30-foot perimeter frame double-drop trailer. The width of the trailer in its operational configuration (to include the stairs) is 18-3/4 feet. The overall height from the ground to the top of the trailer is 8 feet in its traveling configuration. The trailer's ground clearance is 18 inches, except near the rear axles. The center deck surface is 30 inches from the ground.

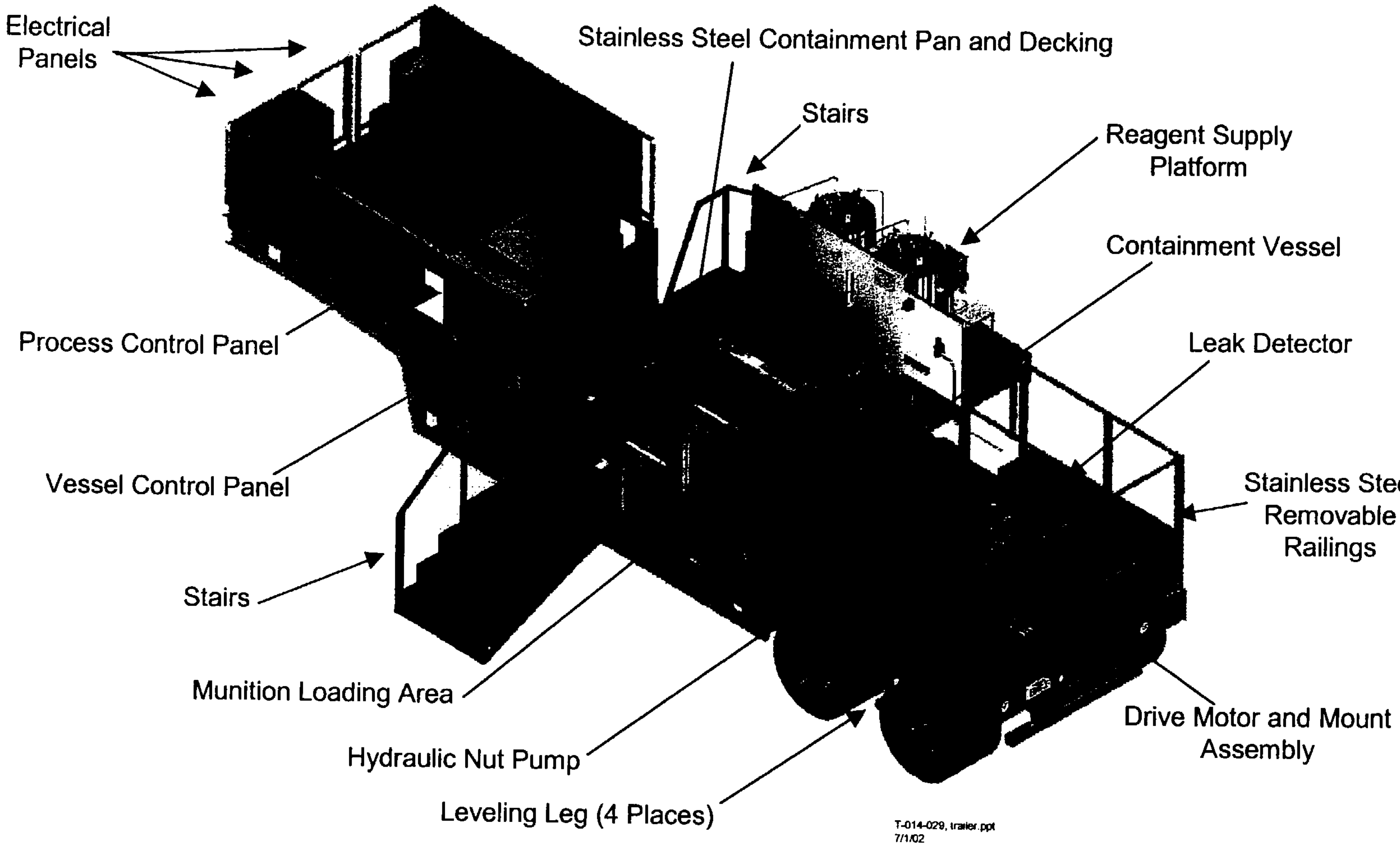

Figure 2-1. The EDS P1U3

The front upper deck of the trailer (the gooseneck) houses the electrical enclosures, while the center deck contains the operating panels and is the working deck; the vessel is mounted to the Rotary Agitation Subsystem located on the rear deck. The secondary containment pan or sump is under the center deck, sloped from the front of the trailer to the rear deck transition, covered by SS grating, and has spray nozzles to flush it with water. A foldout platform for the Reagent Supply Subsystem hinges at the edge of the working deck. The platform is 77 inches wide, 63 inches long, and 36 inches off the ground, and has folding adjustable legs for support in the extended position. It also has a secondary containment pan. Two hydraulic cylinders are used to lower the platform during operations and raise it during travel. An air-operated double diaphragm pump is used to drain the secondary containment pans.

2.3.1.2 Containment Vessel Subsystem. The containment vessel is where the item being destroyed is accessed and the fill materiel treated. The vessel is designed to contain the blast and fragments created when the explosive is detonated as well as prevent the release of chemical agent liquid or vapors.

The 6-1/2 cubic foot vessel assembly consists of the 316 SS vessel, 316 SS vessel door, vessel door hinge, valve/sample panel, clamps, clamp rods, four hydraulic nuts, Grayloc® all-metal door seal, vessel heaters with insulation and a shroud, and a rotational hub/shaft assembly. The vessel, fabricated by Grayloc® Products, is designed to contain repeated detonations of up to a net explosive weight (NEW) of 1 pound (trinitrotoluene [TNT] equivalent). The vessel body is a 43-5/8-inch long cylindrical cup with an inside diameter of 19-3/4 inches and walls that are 2-1/8 inches thick (includes a 1/8-inch damage allowance); the rear is 4-1/2 inches thick. To aid in agitation, a 2-inch tall by 4-1/4-inch wide by 31-1/2-inch long dovetail-shaped paddle is machined onto the interior of the vessel. The vessel was designed and fabricated to American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, Division 1 (1995 Edition) and was tested to 4,200 pounds per square inch (psi) to provide a rated working pressure of 2,800 psi at 125°F (52°C).

The vessel door, which is hinged to provide access to the vessel's interior, is a 7-inch thick plate the same diameter as the vessel. Vessel door features include:

a. *Door Hinge and Vessel Support Jack.* The door hinge assembly consists of the hinge pin, bushings, features to open and close the door and adjust vessel alignment, and a mechanical stop to prevent full opening of the door until the vessel support jack is in position. The vessel support jack is a hand-crank jack located beneath the vessel door hinge. It releases the mechanical door-open interlock and supports the vessel hinge when the vessel door is open. The jack is on a pintle so that it swivels downward and away from the door hinge and does not impede the vessel's rotation.

b. *Feedthroughs.* The door has five drilled-through machined ports for fluid, electrical, and diagnostic feedthroughs. Three of the vessel door feedthroughs are configured to accommodate fluids: a fluid drain line port, a gas sample/fluid inlet port, and a liquid sample port. The inner threads of these ports are counter-bored into the door to protect the threads. The inner face of the fluid drain line has a 3/8-inch diameter dip tube with a filter to prevent blockage of the port.

   The gas sample/fluid inlet port can accommodate a spray nozzle that is flush with the inner door surface. The liquid sample port, also used as a backup drain line when fitted with an adapter, has a 1/4-inch dip tube. The outer faces of these ports are machined to accept 3/8-inch high-temperature (450°F [232°C]), medium-pressure (20,000 psi) packed-stem Autoclave™ valves with metal-to-metal seals. These valves provide no visual indication of their position.

   The fourth vessel door feedthrough is a 2-43/64-inch hole that is used for the electrical feedthroughs. Four electrical high-voltage feedthroughs are assembled on an 8-1/2-inch diameter by 2-3/4-inch thick SS flange that is secured to the door with eight 3/4-inch bolts and sealed using a Grayloc® metal seal with an ethylene propylene diene monomer (EPDM) O-ring.

The final vessel door feedthrough is a machined in-place thermowell for a standard thermocouple (not a through hole). The thermowell end is flush with the inside of the door. On the inner side of the door, a 2-inch deep, 1/2-inch radius countersink is machined around the end of the thermowell to improve temperature measurement.

Although the feedthroughs were designed to minimize fragment impact during detonation and vessel rotation by concentrating them along the outer perimeter of the vessel and recessing them into the door as much as possible, blast protection caps are used to provide additional protection on most of the ports. The port for the high-voltage feedthroughs uses a two-piece removable blast protection cap that consists of a 7-inch diameter ring attached to the inner door using four 3/8-inch screws. A 3/8-inch thick cover is secured onto the ring after the interior detonator jack is in place. Each fluid port, with the exception of the gas sample/fluid inlet port, is protected with a 2-1/4-inch diameter flanged blast cap. The caps have ample through holes to allow reagents to reach the feedthroughs. The gas sample port does not have a blast cap because the spray nozzle (if used) does not protrude beyond the door face.

c. *Sample Assemblies.* The vapor sample assembly, the liquid sample assembly, and the drain port assembly are attached to their respective ports on the vessel door. Samples are collected in a 25-milliliter SS sample bottle attached onto the bottom port of a three-way medium-pressure valve that is installed in the sample assembly. The two sample assemblies are mounted on horizontal slide brackets and have a shut-off quick-connect for reagents, water, helium, or vacuum. The drain port assembly consists of two medium-pressure valves in series. A pressure transducer is between these valves; a quick-connect that connects to an effluent hose is after the second valve.

A Grayloc® metal gasket along with an EPDM O-ring is used for the seal between the main vessel door and the vessel body.

The vessel and its contents are heated by three external 25-kilowatt (kW), 480-volt (V), 3-phase band heaters. Insulation with a metal shroud covers the band heaters. Power to the heaters is through a 50-ampere (amp) slip ring on vessel rear-end shaft. A thermocouple measures the interior temperature of the vessel, and a temperature controller is located on the operator control panel.

2.3.1.3 Hydraulic Nut Subsystem. Hydraulic nuts provide the required pre-load on the vessel clamp to ensure gas-tight vessel operation. Hydraulic nuts use high-pressure hydraulics to load or stretch the bolts (threaded clamp rods) axially. The four hydraulic nuts are operated simultaneously (through a pendant control) to tension the four clamp rods. Once the vessel door is closed, knurled nuts on opposing ends of the clamp rods are turned by hand until the initial required gap is obtained between the clamps. The hydraulic nuts then are pressurized to the preset pressure (to give the required clamp pre-load). Once the required load or stretch is achieved, the locking rings are run down to retain the load, and the pressure is released. The hydraulic line then is disconnected from the nut pump manifold.

The vessel clamp is opened by repressurizing the hydraulic nuts and backing the locking ring off each nut. Following release of the pressure, the clamp threads are loosened to the point that the clamp nuts then can be loosened by hand.

2.3.1.4 Rotary Agitation Subsystem. The vessel, which sits on casters, is agitated using a rotary drive system mounted behind the vessel and attached to the vessel by a shaft with a coupler. It consists of a 1-horsepower, 480-V, 3-phase motor, with a gearbox and a variable frequency drive. Speed, rotation travel, and other motor parameters are programmed at the vessel control panel that has a pushbutton console, indicating lights for statuses and alarms, process controller and displays, and an audio alarm. The vessel automatically rotates at a speed of 2 revolutions per minute. The home position is defined as the door hinge at the 9 o'clock position. During normal stops, the vessel returns automatically to its home position. During draining, the drain line aligns automatically to the 6 o'clock position; during sampling, the sample position aligns automatically to the home position.

2.3.1.5 Reagent Supply Subsystem. Reagents used for chemical treatment and water are stored in two 65-gallon SS tanks. Tank 1 is intended for water and Tank 2 is intended for monoethanolamine (MEA) or other reagents. Each tank has an external heater (8 kW, 480 V) on the bottom for freeze protection, to make viscous fluids easier to pump, and to increase kinetics during chemical treatment. Heat shields are used to protect the workers from contact with the hot tanks. The temperature is measured by a dual thermocouple in each tank, and a temperature controller is located on the vessel control panel. The tanks are ASME rated for 60 psi at 212°F (100°C), but operate at atmospheric pressure. Magnetic float level gauges provide a visual indication of the liquid level, and a low-level switch with alarm cuts power to the tank heaters. Both tanks can be rinsed or filled with water through a spray nozzle at the top of each tank. However, reagent or water is normally supplied to the tanks via quarter-turn valves located at the bottom of the tanks. The tanks are gravity drained through the same quarter-turn valves. The transfer lines from the pumps connect to the tanks with SS tubing, fittings, and Teflon®-lined SS braided flex hoses. The reagent supply panel contains the valves that control the Reagent Supply Subsystem, and the hose docking station holds the various hoses during vessel rotation.

Air-operated double diaphragm pumps are used to transfer reagent and water into their respective supply tanks. The water pump also is used to supply water to the nozzles in the secondary containment pan.

Wanner Engineering Hydra-Cell® air-driven pumps are used to transfer reagent and water from their respective supply tanks to the vessel. The supply pumps are capable of providing 2 gallons per minute at up to 1,000 psi. Check valves prevent back flow of fluids from the vessel.

2.3.1.6 Waste Transfer Subsystem. The liquid effluents are drained from the vessel to a standard 55-gallon waste drum. The drum is protected from overpressurization by a 10-psi rupture disc. In the event of a disc rupture, an alarm sounds and a valve automatically closes to halt the flow of effluent into the waste drum. Two waste drums (waste drums 1 and 1A) are connected to a three-way selector valve in the drain line from the vessel. The valve can be switched to fill the second drum when the first drum becomes full. These drums are vented through another drum (waste drum 2) that exhausts to either a carbon filter canister or a Vapor Containment System (VCS) filter. The third drum (waste drum 3) is used to collect any liquids that have collected in the secondary containment pans. Waste drums 1, 1A, and 3 sit in secondary spill containment on mechanical 1,000-pound capacity scales. An open-top drum is used for solid wastes.

2.3.1.7 Electrical Subsystem. The Electrical Subsystem provides the required 480-V, 3-phase electrical power for the EDS trailer to power the vessel, supply tank heaters, rotary agitation, hydraulic nuts, lighting, and power tools. Electrical power can be supplied by utility power (100-amp minimum) or by a generator (178 kW, 480-V mobile generator). The maximum electrical load is 95 kilovolt-ampere (kVA); and during normal operations, the system can draw a maximum of 114 amps. Electrical enclosures in the process area meet the National Electrical Manufacturer's Association (NEMA) 4X requirements for outdoor and corrosive use; all others are specified as NEMA 4 for outdoor use. The heating and monitoring system for the supply tanks is designed to meet National Electrical Code Class 1, Division 2 Area Classification. Electrical Subsystem features include:

a. *Power Distribution.* The main power distribution panel distributes necessary power to the 480-V process equipment. A 30-kVA transformer steps down the 480 V to 208/120 V, and a second power distribution panel distributes power to 120-V process equipment and utility systems.

b. *Grounding.* All electrical and mechanical equipment is grounded through a bonding system on the trailer frame to a common ground.

c. *Lightning Protection (Optional).* Collapsible lightning rods can be installed on top of the handrail at each end of the trailer; these are connected to the trailer grounding system.

d. *Utilities.* Several dedicated 120-V receptacles and some with ground fault circuit interrupters are installed throughout the trailer. One receptacle is dedicated and labeled as "Sensitive Equipment Only."

e. *Data Acquisition.* All displays and operator controls are wired to interface with (optional) local or remote data acquisition.

2.3.1.8 Explosive Opening Subsystem. Explosive-shaped charges are used to access the fill material inside the item being destroyed, thereby releasing the chemical fill into the vessel. The shaped charges also are used to attempt to destroy the munition burster explosives (if present). This system consists of the Firing System and the Fragment Suppression System (FSS), as follows:

a. *Firing System.* The Firing System is a dual-channel, fully redundant firing system designed to reliably fire four exploding bridge-wire detonators. It is operated through a detachable control module that allows the operator to arm and fire the Firing System from up to 300 feet away. Including separation provided by the 50-foot detonator cables, the Firing System can be operated up to 350 feet from the vessel. The Firing System includes various features necessary to safely fire the detonators and to test and monitor the system and detonator cables. These features include a safety interlock plug to prevent inadvertent operation of the system.

b. *FSS.* The FSS serves as a structural framework to connect, hold, and align the explosive charges used for munition opening and burster charge detonation. It also protects the interior surfaces of the vessel from the high velocity fragments from the shaped charges, burster casing, and munition. FSS designs are available for the 75mm projectile, 4.2-inch mortar, Livens projectile, and the M139 bomblet.

The lower shell of the FSS is connected to a sheet metal frame that holds it off the bottom of the vessel. Between the frame and the lower shell is a stopper block that stops the residual conical-shaped charges (CSC) jets. The munition holder, which also holds a linear-shaped charge (LSC), is mounted inside the lower shell.

The upper shell has holes drilled in the top for the two CSCs, which are held firmly in place using pre-formed packing and are aimed in the direction of the munition burster. End plates are positioned at each end of the assembled shell halves to protect the ends of the vessel.

Steel spring clips hold the detonators onto the LSC and the CSCs, and binder clips for cable strain relief protect the connections between the detonators and shaped charges.

2.3.2 Required Support Systems. Although the following are not part of the EDS, they are required support systems:

- Air compressor (capacity of 185 cubic feet per minute [cfm] at 150 pounds per square inch gauge [psig])

- Electrical generator (capacity of 165 kW, 206 kVA, 277 to 480 V, 3-phase)

- Explosives transport and storage

- Monitoring and laboratory support

- Storage facility for generated wastes pending shipment to a treatment, storage, and disposal facility (TSDF)

- Emergency response personnel.

2.4 VCS

A VCS will be erected around the EDS. The VCS is used primarily to provide environmental control of the workspace. Although not anticipated, or expected, the VCS also will provide secondary vapor containment over the EDS operation should an unexpected release of agent occur during loading of an item into the EDS.

The VCS will have a carbon filtered exhaust system that will maintain a negative pressure within the VCS relative to the outside air and will capture any agent vapors that may result if an item should leak while it is being prepared for placement inside the EDS vessel.

2.4.1 Design. The VCS is a modular building consisting of a series of arched aluminum ribs integrally connected by modular architectural membrane panels.

The VCS meets the following codes:

- National Fire Protection Association (NFPA) 701, *Fire Tests for Flame Resistant Textiles and Film*

- Uniform Building Code (UBC) 31-1, *Flame Retardant Membranes*

- Underwriters Laboratory (UL)-214, *Tests for Flame-Propagation of Fabrics and Films*

- American Society for Testing and Materials (ASTM)-E84, *Standard Test Method for Surface Burning Characteristics of Building Materials.*

The VCS will be 30 feet wide by 50 feet long by 16 feet 10 inches high. The structure is assembled by bolting together 2x10-foot preformed 14 gauge Galvalume® panels that are also bolted to a W8x18 steel beam base. The steel beam base is placed on a sandbag foundation to ensure a stable foundation and a good seal with the ground. The structure is equipped with a 12x12-foot roll-up door centered in one end. There also is a standard personnel door on both ends of the structure. There is a 2x2-foot opening in one end of the arch for connection to the filtration system and there is a 3x3-foot louvered opening in the opposite end of the structure for providing makeup air.

The floor of the VCS will be leveled ground covered with heavy plastic sheeting.

The exhaust filtration system for the VCS consists of prefilters, high efficiency particulate air (HEPA) filters, and carbon filters along with a motor, fan, and ductwork. Operation of the exhaust system will be monitored by pressure gauges that measure head loss across the filters. If head loss across a filter exceeds a predetermined limit (specified in the manufacturer's literature), then that filter will be changed. If the pressure difference between the VCS and the outside air should fall below the specified limit, the system will be inspected and adjusted to correct any defective parts or settings.

The carbon filters in the VCS filtration system contain 800 pounds of carbon. This is far in excess of the amount needed to contain the agent that would be released from one item should it leak when being loaded into the EDS vessel. Based on data from Holgate, 1993, the carbon filter has a loading capacity of between 0.5 and 0.6 pound of agent per pound of carbon for HD and GB. (Based on table 2-2 in Holgate, 1993 and assuming an agent vapor concentration expected with a munition or cylinder leaking its entire contents.) Therefore, the filter as a whole could absorb between 400 and 480 pounds of HD or GB. Since the largest item to be treated would contain no more than about 6.0 pounds of agent, the carbon filtration system provides significantly greater capacity than would be needed in case of a leak.

2.4.2 Security Requirements. CWM will not be stored in the VCS. The doors to the VCS will be equipped with locks. The doors to the VCS will be locked when personnel are not onsite. Physical security will be provided to this site in accordance with DPG policy.

2.5 Other Support Equipment

2.5.1 Generator. Electrical power for the EDS site will be requested via connection to the DPG distribution system. A generator will be provided as a backup power supply for critical systems should line power fail. If line electrical power is not provided, generator power will be used.

2.5.2 Air Monitoring Shelter. Air monitoring equipment will be housed in a shed/trailer with sampling lines running to the various sampling points around the EDS.

2.5.3 Operational Command Post. An operational command post trailer equipped with the necessary computers and communications equipment to control operations and data collection functions will be located at the EDS site.

2.5.4 Plumbing. The EDS site does not require connection to a water supply or sewer system. Drinking water will be provided in designated break areas. Water for operation of the EDS and Personnel Decontamination Station (PDS) will be brought onsite as needed and stored in tanks. Liquid wastes generated in the PDS will be containerized.

2.5.5 Explosives Storage. Explosives used during EDS operations will be stored in accordance with DA policy and brought to the EDS as needed.

2.5.6 PDS. A PDS will be set up in accordance with the site-specific HASP for personnel to remove personal protective equipment (PPE) when leaving the exclusion zone.

2.5.7 PPE Change Area. Facilities will be provided for personnel to don PPE and to shower after passing through the PDS.

2.5.8 Break Room Area/Crew Trailer. A break room area/crew trailer will be provided for onsite personnel.

2.5.9 Observation Area. An observation area, equipped with closed-circuit television, will be provided so that CWC inspectors can monitor the destruction process without having to enter the exclusion zone.

2.5.10 Toilet Facilities. DPG will provide portable toilet facilities for onsite personnel.

2.6 Recommended Meteorological Conditions

Movement of an item from the storage facility to the EDS and loading it into the EDS will be halted or postponed if severe weather conditions (such as a tornado) threaten. Operations personnel will check the local meteorological forecast to ensure that acceptable conditions exist and are not expected to change during the time needed to load the item into the EDS vessel. Operations will be scheduled for a day when the predicted weather conditions preclude the No Significant Effects (NOSE) from reaching beyond the maximum credible event (MCE) calculated distance or reaching a sensitive offsite target. If, on the scheduled day, weather conditions, such as wind direction or atmospheric stability, unexpectedly cause the NOSE to extend beyond the MCE hazard distance or reach a sensitive offsite target, the EDS System Manager may delay or postpone operations until weather conditions again become favorable. Note: The MCE calculated hazard distance only applies to handling the munition outside the EDS. Once the munition is sealed inside the EDS vessel, the blast, fragmentation, and chemical agent hazards are confined to the interior of the EDS vessel.

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SECTION 3
OPERATIONS

The following paragraphs describe the operation of the EDS and the hazard distances associated with these operations.

3.1 EDS Functional Description

The EDS will be operated in accordance with established EDS operating procedures. Figure 3-1 shows operating procedures for HD and figure 3-2 shows procedures for GB.

3.1.1 Pre-Operations. Upon arrival at the treatment location, the EDS is set up, inspected, and prepared for operations. During setup, secondary containment (polyvinyl barrier) is established under and around the EDS trailer. If electrical power is not available from a nearby utility power source, an electrical generator is used. Electrical equipment then is checked for operability. Any necessary equipment/instrument calibrations are performed.

After the EDS has been set up and inspected, but before treatment of a chemical-filled item can begin, baseline air monitoring will be completed by ECBC personnel in accordance with Site Monitoring Plan (SMP) requirements. Prior to sequencing into toxic operations, a Pre-Operational Survey is conducted.

Pre-mixed reagent is pumped from drums or bulk containers into the reagent supply tank. The water supply tank is filled with water. The supply pumps are checked for operability.

OPERATION: Destruction of HD-Filled *(Munition type)* in the Explosive Destruction System Phase 1 Unit 3 (*Munition ID#*):

OPERATION DATE:

TIMES	**PROCEDURES**
	■ Fill Supply Tank 1 with water and Supply Tank 2 with MEA during morning pre-op.
	■ Set Supply Tanks 1 and 2 temperature settings to 60°C.
	■ Prepare door, Hi-Pot, and Load FSS with *(quantity and type of munition)*.
______	■ Close door, push clamp closed, and tighten hydraulic nuts. Gaps: Top ___ Bottom ___
______	■ Perform helium leak test on vessel door and high voltage flange. Vessel: ___________ High Voltage Flange: ___________
______	■ Conduct detonation.
	■ Reduce Supply Tank 2 Heater to 40°C.
	■ Add 85 liters of MEA heated to 60°C. (Obtain from Tank 2).
	■ Set vessel temperature to 60°C.
______	■ Agitate vessel for 4 hours.
______	■ Collect liquid sample from valve panel in 25-mL sample bottle (one-hour sample). Results ______________________________________
______	■ Collect liquid sample from valve panel in 25-mL sample bottle (additional samples as needed). Results ______________________________________
	■ Drain liquid in vessel into Drum 1.
	■ Turn off heater to Supply Tank 1.
	■ Add 80 liters of water heated to 60°C. (Obtain from Tank 1).
	■ Set vessel temperature to 105°C.
	■ Change-out RF batteries.
______	■ Start vessel agitation.
______	■ Continue vessel agitation for 2 hours after vessel temperature reaches 100°C.
	■ Reset vessel temperature to 100°C.
______	■ Turn off vessel heaters and stop vessel agitation.
	■ Install 12-hour DAAMS tubes above vessel door, waste drums, and at filter midbed. (ASSURE 12-hour cycle ends after 7:15 a.m).
	■ Close all valves and turn off RF box on valve panel.

PLANNED OVERNIGHT STOP

OPERATION DATE:

TIMES	**PROCEDURES**
	■ Assure valve 23 is open, install charged RF batteries and RF box is on to monitor vessel pressure.
	■ Agitate vessel for 10 minutes.
	■ Collect liquid sample from valve panel in 25-mL sample bottle (rinsate liquid sample), if necessary, based on neutralent results IAW Sampling Analysis Plan.
	■ Drain liquid in vessel into Drum 1A.
	■ Fill vessel with 65 liters of ambient temperature water from Tank 1.
	■ Agitate vessel for 20 minutes.
	■ Drain liquid from vessel into Drum 3.
	■ Conduct 500 psi helium flush.
______	■ Collect Tedlar Bag vapor sample. Results: ____________________________
______	■ Open vessel door.
______	■ Clean and prepare equipment.
	■ Bag solid wastes and door parts.

______________________________ EDS System Manager Date ________________

Figure 3-1. Operations Order for Mustard Operations

OPERATION: Destruction of GB-Filled *(Munition type)* in the Explosive Destruction System Phase 1 Unit 3 (*Munition ID#*):

OPERATION DATE:

TIMES	PROCEDURES
	■ Fill Supply Tank 1 with water and Supply Tank 2 with MEA during morning pre-op.
	■ Set Supply Tanks 1 and 2 temperature settings to 60°C.
	■ Prepare door, Hi-Pot, and Load FSS with *(quantity and type of munition)*.
______	■ Close door, push clamp closed, and tighten hydraulic nuts. Gaps: Top ___ Bottom ___
______	■ Perform helium leak test on vessel door and high voltage flange. Vessel: ___________ High Voltage Flange: ___________
______	■ Conduct detonation.
	■ Turn off Supply Tank 2 Heater.
	■ Add 110 liters of MEA heated to 60°C. (Obtain from Tank 2).
	■ Set vessel temperature to 25°C.
______	■ Agitate vessel for 4 hours.
______	■ Collect liquid sample from valve panel in 25-mL sample bottle (one-hour sample). Results ______________________________________
______	■ Collect liquid sample from valve panel in 25-mL sample bottle (additional samples as needed). Results ______________________________________
	■ Drain liquid in vessel into Drum 1.
	■ Turn off heater to Supply Tank 1.
	■ Add 110 liters of water heated to 60°C. (Obtain from Tank 1).
	■ Set vessel temperature to 105°C.
	■ Change-out RF batteries.
______	■ Start vessel agitation.
______	■ Continue vessel agitation for 1 hour after vessel temperature reaches 100°C.
	■ Reset vessel temperature to 100°C.
______	■ Turn off vessel heaters and stop vessel agitation.
	■ Install 12-hour DAAMS tubes above vessel door, waste drums, and at filter midbed. (ASSURE 12-hour cycle ends after 7:15 a.m).
	■ Close all valves and turn off RF box on valve panel.

PLANNED OVERNIGHT STOP

OPERATION DATE:

TIMES	PROCEDURES
	■ Assure valve 23 is open, install charged RF batteries and RF box is on to monitor vessel pressure.
	■ Agitate vessel for 10 minutes.
	■ Collect liquid sample from valve panel in 25-mL sample bottle (rinsate liquid sample), if necessary, based on neutralent results IAW Sampling Analysis Plan.
	■ Drain liquid in vessel into Drum 1A.
	■ Fill vessel with 65 liters of ambient temperature water from Tank 1.
	■ Agitate vessel for 10 minutes.
	■ Drain liquid from vessel into Drum 3.
	■ Conduct 500 psi helium flush.
______	■ Collect Tedlar Bag vapor sample. Results: ____________________________
______	■ Open vessel door.
	■ Clean and prepare equipment.
______	■ Bag solid wastes and door parts.

_____________________________   ____________________

EDS System Manager   Date

Figure 3-2. Operations Order for GB Operations

3.1.2 Accessing Items with Shaped Charges. The item to be destroyed[1] is transported to the EDS, unpacked as necessary, and prepared for processing. Once an item has been placed in the vessel, the contents must be exposed before it can be chemically treated. The fill is accessed with a four-part system consisting of an LSC to open the item, CSCs to penetrate and attempt to detonate the burster, an FSS to prevent damage to the vessel, and a high-voltage modular firing system. This four-part system is described in the following paragraphs:

a. *LSC.* The LSC is used to access the item to expose the contents for chemical treatment. The primary requirement, cutting the walls of the item, is accomplished with a pre-formed length of copper-sheathed LSC with a cyclonite (RDX)-based explosive filler. The shape, length, and grains per foot of the LSC are specific for the type of item to be treated.

Exploding bridge-wire detonators are connected to the LSC at each end. Detonator cables are connected to the detonators, strain relieved, and then electrically shorted until the FSS is positioned in the vessel. Only a single detonator is required, but two are used for redundancy.

b. *CSC Burster Initiator.* CSCs are used to puncture a munition's burster and attempt to detonate the burster's explosives. Depending on the munition type and the X-ray for the munition, one or two CSCs are positioned on the upper shell of the FSS above the munition.

The CSC used to penetrate the burster is a 32-gram, Composition A-3, multi-tapered, copper-lined CSC. The design of the CSC is such that the criterion for reliable detonation of the burster explosives by impact of the shaped charges is exceeded. This is necessary due to the effects of

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1 The plan is to process each item separately. It is possible that more than one item may be processed at a time if the fills of the items are the same and the quantity of explosives placed in the EDS do not exceed the design limitation. Should approvals be obtained to process more than one item at a time, the EDS System Manager will make the decision whether to proceed one item at a time.

explosives aging or the possible contamination of the explosive by the chemical fill.[2]

c. *Detonators.* The firing system is used to simultaneously initiate the LSC and the CSC charges. The detonators used to initiate the CSCs are Reynolds type RP-2® exploding bridge-wire detonators, and an RP-1® detonator is used for the LSC. These detonators are very insensitive to unexpected or undesirable energy inputs (static, impact, etc.) and are detonated by the discharge of high current through the bridge-wire. The bridge-wire explodes and produces a shock wave, which, in turn, initiates the explosive in the shaped charges. The RP-1 detonators have a 251-milligram pentaerythritol tetranitrate explosive, a 375-milligram RDX with binder output pellet, a 315-amp at 415-kW ignition requirement, and a 2.75 microsecond (μsec) function time.

The item is unpacked, as necessary, and placed into the FSS. The LSC is attached to the bottom shell and CSCs, when used, are attached to the upper shell of the FSS. The detonators are attached to the charges, strain relieved, and electrically shorted for safety. The detonator leads are pre-checked for electrical continuity. Once the system is assembled, it is placed into the vessel using the munition loading table.

Once the entire assembly—item to be destroyed, FSS, shaped charges—has been placed inside the vessel, the final detonator connection is made using the interior detonator jack. With a clean, dry lubricated sealing surface, the seal mounted on the vessel's sealing surface, and the EPDM O-ring properly seated in the door, the door is closed and the door clamps are pushed closed. The clamp rods then are tightened using wrenches and the hydraulic nuts.

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2 As the burster may not actually detonate, the solid debris is inspected for intact or partially intact explosive components after the treatment process is complete.

The integrity of the seals on the vessel door and the high-voltage flange then are confirmed. Afterwards, the firing sequence is initiated and the explosives are detonated.

3.1.3 Chemical Treatment. Appropriate reagent then is pumped/sprayed into the vessel to treat the chemical fill. The primary reagents used for chemical treatment include:

- Mustard and its variants – 90 percent by volume MEA/10 percent by volume water (hereafter referred to as 90 percent MEA reagent)

- GB – 45 percent by volume MEA/55 percent by volume water (hereafter referred to as 45 percent MEA reagent).

The treatment levels for mustard and GB are shown in table 3-1.

All the reactions are exothermic. Some reactions can generate significant energy; however, with the large thermal mass of the thick-walled vessel, the heat of the reaction only aids in warming the vessel and does not create dangerous pressures.

Table 3-1. EDS Treatment Level

Chemical Warfare Materiel / Reagent	Treatment Level[a] (mg/L)
H, HD, or HT (all measured as HD) / MEA and water	50
GB / MEA and water	50

Notes:

[a] Nominal treatment level is system-specific; level of treatment will be determined by evaluation

GB = sarin
H, HD, HT = mustard agents
MEA = monoethanolamine
mg/L = milligram per liter

The CSCs are anticipated to detonate or at least ignite the burster; however, traces of unreacted explosives from the burster may remain. MEA has been shown to effectively destroy TNT and tetryl. Chemical treatment of explosives in the EDS is meant only to destroy trace amounts of explosives, not as a method for bulk explosives destruction. Remaining explosive pieces would be separated from the other solid wastes and disposed of separately.

Treatment of the chemical agent and decontamination of the munition or cylinder fragments is accomplished within the sealed vessel. For mustard-filled items, the vessel is heated to 140°F (60°C) and agitated after the addition of the 90 percent MEA reagent (preheated to 60°C). A neutralent sample is taken for analysis and vessel agitation is restarted.

If the 1-hour sample results are below the treatment level for mustard, chemical treatment is considered complete.

If the 1-hour results are above the treatment level for mustard, chemical treatment is continued and samples are taken every hour and are considered complete once the neutralent meets the treatment level.

The neutralent is then drained into a waste drum and the vessel is treated/rinsed with clean water. The first water rinse is preheated to 60°C and then heated to 100°C inside the vessel with continued agitation for 2 hours after the vessel contents reach 100°C. A second rinse is performed using ambient temperature water. The vessel is then flushed with helium and a vapor sample taken to verify that chemical agent vapor concentration in the vessel is below hazardous levels before opening the vessel door.

The solid wastes are visually inspected, removed from the vessel, placed into a waste container, and sealed. Should any explosive components be found, they will be segregated from the other solid wastes. The vessel is rinsed with water to remove any remaining solid debris. Drums and containers containing waste products are stored and managed as hazardous waste.

For GB-filled items, chemical treatment is similar to that for mustard, except that the vessel is heated to a minimum of 25°C after addition of the 45 percent MEA reagent. In addition, the hot water treatment time is 1 hour for GB versus 2 hours for HD.

3.1.4 Preparation for Next Item. Before treatment of each subsequent item, the vessel is systematically cleaned and inspected. This process includes visually inspecting the vessel, its sealing surface, and its door; making any necessary repairs; replacing the door seal and EPDM O-ring on the vessel door; and replacing the electrical feedthroughs, as necessary.

After approximately every fifth item treated, the following maintenance will be performed: inspect the containment system, inspect and leak test the sample panel, inspect rotary agitation system, inspect reagent supply system, inspect the ball valve, and inspect electrical power cables and cords. Any identified deficiencies will be repaired before proceeding with the next destruction.

3.1.5 Closeout. Upon completion of operations, the EDS is closed out. Closeout activities include cleaning, decontaminating, and monitoring the vessel and equipment; stowing all equipment and supplies; transferring hazardous waste to an approved TSDF (or arranging for its transfer); and preparing the EDS for transport from the treatment location.

3.2 Hazard Distance

The EDS vessel has been demonstrated to contain the chemical agent, blast, and fragments released when the munition is destroyed and the fill treated. However, before the munition has been placed inside the vessel, there are potential hazards to which the workers, public, and environment could be exposed. To determine potential hazard distances, the hazard posed by the chemical agent fill and the hazard posed by the explosives contained in the CWM munitions or used to operate the EDS will be considered separately.

3.2.1 Chemical Agent Hazard Distance. In the event of a chemical agent release, chemical hazard distances will be calculated using the D2PC model based on the type and quantity of chemical agent released, the circumstances that resulted in the release, and the weather conditions at the time of release. For planning purposes, a MCE has been identified and the hazard distances for that event modeled. The MCE was identified as the evaporative release of 2.6 pounds of GB from the M125 bomblet, which has a 1 percent lethality distance of 181 meters. Table 3-2 shows the D2PC results for modeling the MCE and other possible events. Attachment 2 to annex A is a complete printout of the D2PC run for each type of munition and cylinder showing all inputs and outputs.

3.2.2 Explosive Hazard Distance. Explosive hazards include the fragmentation hazard and the blast hazard and are determined from quantity-distance (Q-D) tables in Department of the Army Pamphlet (DA Pam) 385-64. The combined NEW for the explosives contained in the item being treated and the donor explosives that will be used to operate the EDS is less than 1 pound. The total NEW of explosives onsite will be less than 5 pounds. Therefore 5 pounds of NEW was used to determine blast and fragmentation distances. In accordance with table 5-1 in DA Pam 385-64, the inhabited building distance (IBD) is 1,250 feet.

3.3 Movement of Item to EDS

Munitions will be handled by trained explosive ordnance disposal (EOD) personnel following EOD procedures. DOT cylinders will be handled by personnel trained in CWM handling. When the EDS is ready, the next item will be retrieved from Igloo G and transported to the EDS following CWM escort procedures. The transport distance is approximately 122 meters and is entirely within the confines of the restricted area at DPG. Therefore, no public roads or congested areas will be traversed.

Table 3-2. Chemical Agent Hazard Distances for MCE[a]

Item Description	Chemical Agent Fill	Fill Amount	D2PC Results (meters)		
			1 Percent Lethality	No Deaths	No Effects
M125 Bomblet (Evaporative Release)	GB	2.6 lbs	181	243	1,566
4.2-inch Mortar (Instantaneous Release)	HD	6.5 lbs	52	64	439
M139 Bomblet (Evaporative Release)	GB	0.65 lbs	89	119	768
105mm Projectile (Instantaneous Release)	HD	3.17 lbs	35	44	264
4.2-inch Mortar (Evaporative Release)	HD	6.5 lbs	14	18	197
DOT Cylinder (Evaporative Release)	HD	498 mL	5	8	93

Notes:

[a] Results reported in this table were obtained from the D2PC chemical hazard prediction model. Inputs to the model included: location (Dugway Proving Ground [DPG]), season (summer), munition type, agent type, release type (instantaneous or evaporative depending on item), atmospheric stability class (class D). A complete printout of model inputs and outputs is located in attachment A-2 to annex A, Hazard Analysis.

DOT = Department of Transportation
GB = sarin
HD = distilled mustard
mm = millimeter

SECTION 4
ORGANIZATION

The principal organizations involved in implementing this Plan include DPG, PMNSCM, ECBC, and the U.S. Army Technical Escort Unit (TEU). The organization for EDS operations is shown in figure 4-1. Command and control of EDS personnel is shown in figure 4-2.

PMNSCM will provide the EDS and will control operations to ensure that destruction is conducted in a safe and environmentally acceptable manner. TEU will provide EOD personnel. ECBC will provide EDS operators who will perform the destruction procedure. ECBC also will perform air monitoring. DPG will provide support services as needed (for example, medical support and security). Each agency is responsible for providing the supplies and equipment needed for carrying out agency-specific responsibilities.

All support and operational elements will be briefed on the nature of the operation before the item is moved to the EDS for destruction and treatment of the fill material. Personnel and equipment necessary to conduct the operation will be properly positioned. When the PMNSCM EDS System Manager verifies personnel and equipment are in place, destruction will be initiated. The EDS System Manager maintains control and authority over EDS operations and crew. The EDS System Manager, in conjunction with the EDS Crew Chief, will conduct safety briefings.

4.1 DPG

DPG is the supported agency and maintains control of the site at all times. In addition, DPG will coordinate with state regulatory agencies, the U.S. Environmental Protection Agency (USEPA) (if needed), Department of the Army Safety, and DDESB for approval of this Plan.

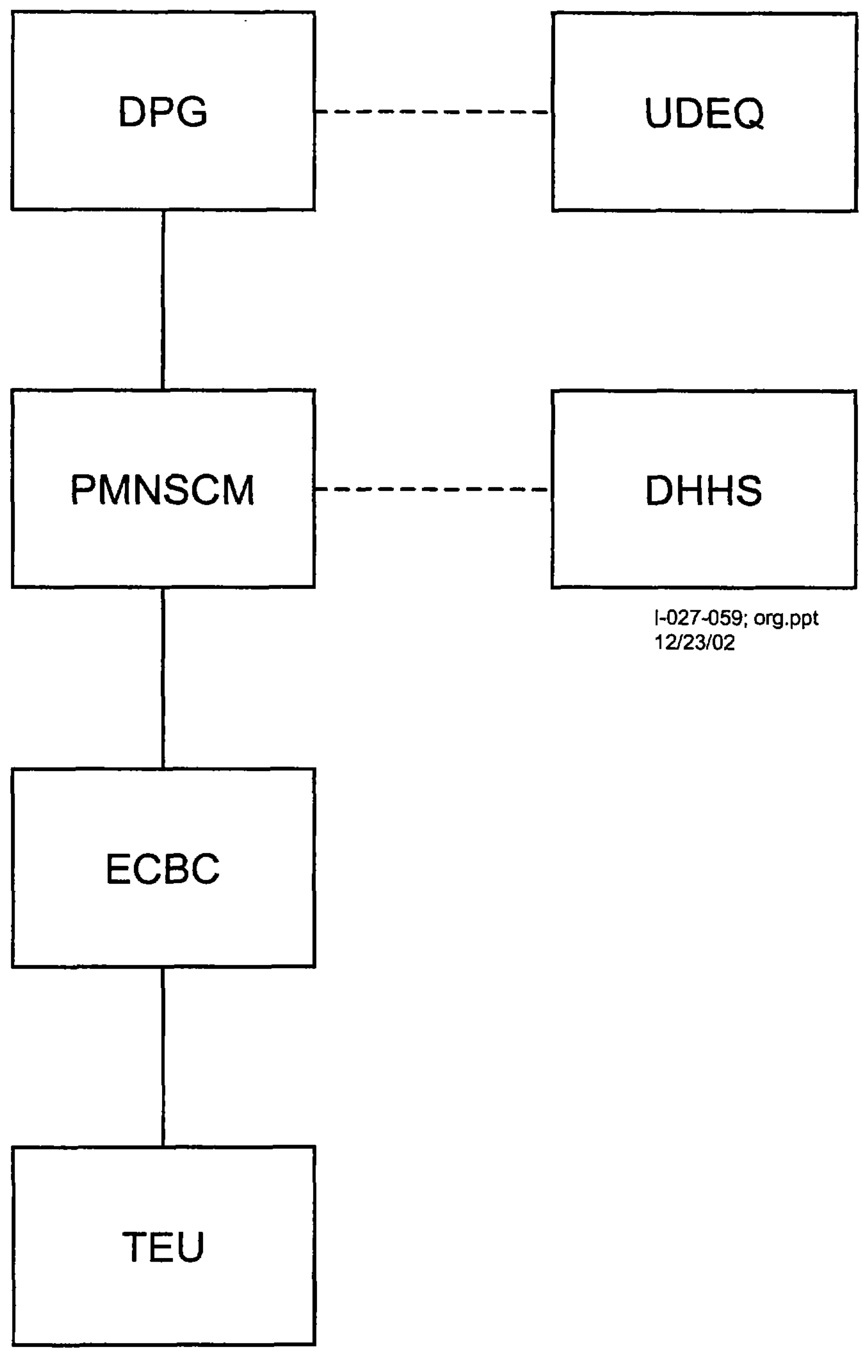

Figure 4-1. Organization for EDS Operations at DPG

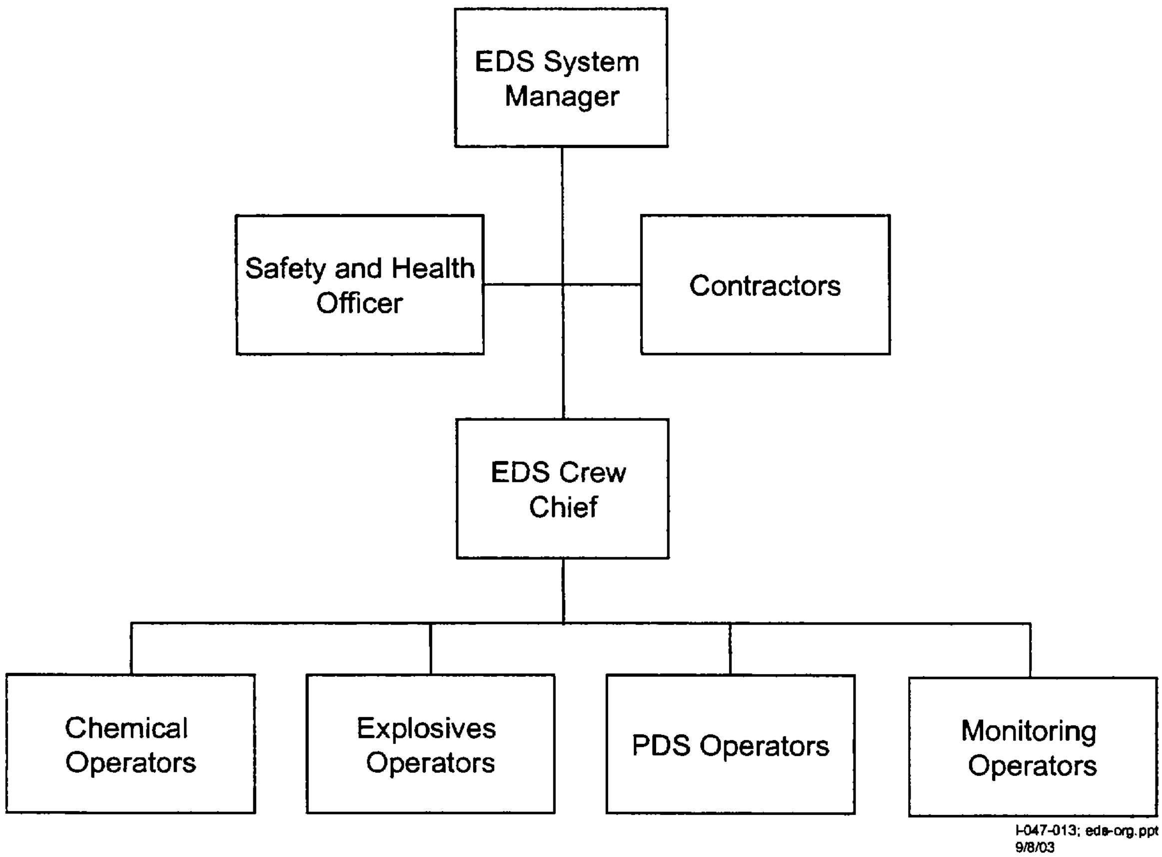

Figure 4-2. EDS Command and Control

DPG will have the lead for public outreach pertaining to the destruction of items at DPG and provide logistical support relating to site access/preparation medical support, fire protection, and security.

4.2 PMNSCM

PMNSCM has programmatic responsibility for the destruction of recovered CWM. PMNSCM will support EDS operations by preparing this Destruction Plan, providing the EDS, and funding the operation. PMNSCM will control and manage all EDS operations. The EDS System Manager or designee will be onsite during operations and will be responsible for briefing the DPG safety representative.

4.3 ECBC

ECBC is the operator of the EDS under direction of the PMNSCM System Manager. ECBC also will provide equipment and personnel for chemical agent monitoring of the EDS work area. ECBC will provide an EDS Field Crew Chief. ECBC will coordinate operations and manning of the PDS. ECBC will coordinate with TEU to provide qualified EOD personnel.

4.4 TEU

TEU will provide EOD personnel for handling the CWM and explosives used in the EDS.

SECTION 5
PUBLIC OUTREACH

DPG has overall responsibility for public outreach and will be the focal point for public inquiries into destruction of the items. DPG will coordinate with participating agencies to obtain information for public release and to ensure all agencies are aware of the public's concerns. Information about the Non-Stockpile Chemical Materiel Program or the EDS will be coordinated with the Program Manager for the Elimination of Chemical Weapons (PM ECW) Public Outreach and Information Office (POIO) before release. Outreach efforts will be integrated into the existing DPG and PM ECW public outreach programs. Participants who become aware of public concerns relating to the destruction activities will share this information with the DPG Public Affairs Office (PAO). PM ECW POIO will integrate site-specific outreach activities into national and regional programs and will prepare fact sheets or arrange for experts to answer questions if requested by DPG PAO.

Public outreach activities will be planned to accommodate the degree of public interest and to address the specific concerns that are voiced. Specific outreach activities may include:

a. Making information available at public repositories

b. Issuing press releases or notices prior to key events (such as announcing the conclusion of operations)

c. Interacting with interested individuals, elected officials, and special interest groups

d. Maintaining a list of interested parties and ensuring that these parties receive information that addresses their concerns

e. Maintaining an outreach presence at a designated location as warranted.

Information about this plan will be distributed through PMNSCM. For additional information or comments, contact the following:

The DPG PAO can be reached at:

Dugway Proving Ground Public Affairs Office
Ms. Paula Nicholson
Phone: 435-831-2116

The PM ECW POIO point of contact is:

Program Manager for the Elimination of Chemical Weapons
Public Outreach and Information Office
Attn: Mr. Jeffrey Lindblad
SFAE-CD-N
Aberdeen Proving Ground, Maryland 21010-5401
Phone: 800-488-0648 or 410-436-4555
FAX: 410-436-5122
E-mail: jeffrey.lindblad@pmcd.APGea.army.mil

SECTION 6
RESULTS OF HAZARD ANALYSIS

The following paragraphs provide a summary of the information contained in the PM ECW HA (annex A) and the Department of the Army (DA) HA (annex G).

6.1 PM ECW HA

Procedures described in this Destruction Plan were evaluated in accordance with the Non-Stockpile Chemical Materiel Product (NSCMP) *System Safety Management Plan* (SSMP) (PMCD, 2001b). The assessment concluded that the items slated for destruction in the EDS at DPG could be destroyed safely.

The MCE for this operation was determined to be the evaporative release of an M125 bomblet before it was secured inside the EDS. Such an accident would result in the evaporative release of 2.6 pounds of GB. The no deaths hazard distance for such an incident was modeled to be 243 meters and the no effects hazard distance was 1,566 meters.

The HA identified 12 hazards. Eleven were assigned a controlled risk assessment code (RAC) 3 and are acceptable upon review by the System Safety Program Manager. One (hazard 001 in annex A) is a RAC 2 and has been accepted by the PMNSCM.

6.2 DA HA

An analysis of CWM handling hazards was conducted in accordance with AR 385-64 (annex G to this Destruction Plan). That analysis identified ten hazards, of which eight were assigned controlled RACs Low and one a controlled RAC Medium. One hazard was assigned a controlled RAC High. That hazard (identified as hazard 002 in annex G) is an explosion hazard from the accidental dropping of an armed/fired munition while moving it from its storage location to the EDS. This would result in a potentially fatal or serious injury and is assessed an initial RAC of ID (High). The controlled RAC also was assigned ID (High). This conservative RAC was assigned because the EOD personnel will not be able to protect themselves from the forces of an explosion.

ANNEX A
HAZARD ANALYSIS

ANNEX A
HAZARD ANALYSIS

1. INTRODUCTION

This hazard analysis (HA) was developed to support the Destruction Plan for 22 items including 4.2-inch mortars, a 105mm projectile, an M139 bomblet half, an M125 bomb, and Department of Transportation (DOT) cylinders using the Explosive Destruction System (EDS) at Dugway Proving Ground (DPG), Utah. The items contain mustard agent (HD, HT) or sarin (GB). This HA is an analysis of hazards associated with handling and destroying recovered chemical munitions and DOT cylinders, hereafter referred to as chemical warfare materiel (CWM) items, at DPG and is performed in accordance with the *System Safety Management Plan for the Non-Stockpile Chemical Materiel Product* (PMCD, 2001b). In the HA, potential incidents that could occur during the destruction process are discussed qualitatively. To assign relative values to potential risk, risk assessment codes (RACs) are identified for each hazard or hazardous condition. This risk assessment encompasses the risks associated with handling, destruction, and treatment of CWM containing H, HD, HT, or GB. Recommended controls for reduction of risks are included in attachment A-1 to this annex.

2. CONCEPT OF OPERATIONS

The items are currently overpacked in propelling charge cans (PCCs) and the DOT cylinders are currently overpacked in multiple round containers (MRCs). All are stored in Igloo G at DPG. After the EDS has been set up and approved to commence disposal operations, the items will be brought to the EDS one at a time.[1] The next item will not

[1] The plan is to process each item separately. It is possible that more than one item may be processed at a time if the fills of the items are the same and the quantity of explosives placed in the EDS do not exceed the design limitation. Should approvals be obtained to process more than one item at a time, the EDS System Manager will make the decision whether to proceed one item at a time.

be brought to the EDS until the treatment of the previous item has been completed and the EDS prepared to receive it; therefore, there will never be more than one item at the EDS site at a time.

The scope of this HA covers siting the EDS, moving the items from the storage location to the EDS, and loading the items into the EDS for destruction and treatment. This HA covers hazards specific to EDS operations at DPG, which are in addition to hazards described in the EDS system HA and reported in the *Explosive Destruction System, Phase 1 Unit 2, Hazard Tracking Log* (PMCD, 2002).

2.1 Assumptions

The following assumptions have been applied to this plan:

- The items contain the fill material and weights or volumes as described in tables A-1 and A-2.
- The items are packed in PCCs or MRCs.
- The Destruction Plan includes movement of the items from their current location to the EDS; destruction by the EDS; treatment of the chemical fill; and waste delivery to DPG for final disposition.
- The U.S. Army Technical Escort Unit (TEU) will mitigate the risk of moving and unpacking the armed munitions; to the extent possible using established explosive ordnance demolition procedures.
- The Product Manager for Non-Stockpile Chemical Materiel (PMNSCM) will address the effects of a mishap of handling CWM on the EDS system and the environment.
- PMNSCM will address the hazards of operating the EDS.

Table A-1. Summary of MARB Data for Munitions to be Destroyed

Item	MARB Number	Munition	Explosive Components	Fill Materiel	Assumed Fill Weight (kg)[a]
1	DPG-94-005	M139 bomblet half	None	GB	0.59 (0.295 per half)
2	DPG-94-006	M60 105mm	No fuze, burster present	HD	1.44
3	DPG-94-007	M125 bomblet	No fuze	GB	1.18
4	DPG-94-012	4.2-inch mortar	No fuze, burster present	HD	1.35 (50% fill)
5	DPG-94-013	4.2-inch mortar	No fuze, burster present	HD	2.7
6	DPG-94-016	4.2-inch mortar	No fuze, no burster, primer present	HD	2.7
7	DPG-94-017	4.2-inch mortar	No fuze, burster present	HD	2.7
8	DPG-94-018	4.2-inch mortar	No fuze, burster present	HD	2.7
9	DPG-94-020	4.2-inch mortar	No fuze, burster present	HD	2.7
10	DPG-94-022	4.2-inch mortar	No fuze	HD	2.7
11	DPG-94-023	4.2-inch mortar	No fuze	HD	0.71 (30% fill)
12	DPG-94-025	4.2-inch mortar	No fuze	HD	0.135 (50% fill)
13	DPG-94-026	4.2-inch mortar	Unarmed, burster present	HD	2.7
14	DPG-94-031	4.2-inch mortar	Fuze and burster present	HD	2.7
15	DPG-94-032	4.2-inch mortar	Burster present	HD	2.7

Notes:

[a] Fill weights are based on the *Old Chemical Weapons Reference* Guide (SciTech, 1998) and information given in the MARB report.

DPG = Dugway Proving Ground
GB = sarin
HD = distilled mustard agent
kg = kilogram
MARB = Materiel Assessment Review Board
mm = millimeter

Table A-2. DOT Cylinders to be Treated in the EDS

Identification Number	Fill Material	Agent Fill Volume (mL)
98501C	HD	323
98502C	HD	498
98503C	HD	498
98504C	HD	497
98505C	HD	498
98506C	HD	193
98508C	HT	44

Notes:

HD = distilled mustard
HT = mustard-T mixture
mL = milliliter

2.2 Facility Description

The EDS site will be located on level ground near Igloo G and accessible to support services and emergency responders. For additional detail of the facility description, refer to paragraph 1.4 of the Destruction Plan.

2.3 Facility Location

The EDS will be approximately 122 meters (400 feet) from Igloo G where the items are currently located. Both facilities are within the confines of the restricted area at DPG.

2.4 CWM Characterization

The items that will be destroyed using the EDS are described in tables A-1 and A-2.

3. HAZARD ANALYSIS

To aid in evaluating identified hazards, potential incident and accident scenarios have been defined and RACs have been assigned in accordance with the Non-Stockpile Chemical Materiel Product (NSCMP) *System Safety Management Plan* (SSMP) (PMCD, 2001b). The RACs are based on combinations of hazard severity categories and hazard probability (or frequency of occurrence) categories. The definitions of the hazard severities and hazard probabilities are listed in tables A-3 and A-4, respectively, and the RAC matrix is provided in table A-5.

A summary of the hazards identified, along with the RACs assigned, is given in attachment A-1. Hazards assigned RAC 1 require corrective action prior to acceptance of the plan. Hazards assigned RAC 2 also require corrective action, but are of lower priority than RAC 1 hazards. If resolutions do not lower the RAC to 3 or 4, the RAC 1 and RAC 2 hazards must be formally accepted by the designated authorities in accordance with the SSMP.

Table A-3. Hazard Severity Categories

Description	Category	Mishap Definition
Catastrophic	I	May cause death, system loss, or severe environmental damage.
Critical	II	May cause severe injury, severe occupational illness, or major system or environmental damage.
Marginal	III	May cause minor injury, minor occupational illness, or minor system or environmental damage.
Negligible	IV	May cause less than minor injury, occupational illness, or less than minor system or environmental damage.

Source: Program Manager for Chemical Demilitarization, *System Safety Management Plan for the Non-Stockpile Chemical Materiel Product*, August 2001

Table A-4. Hazard Probability Categories

Frequency of Occurrence	Level	Description
Frequent	A	Will be continuously experienced.
Probable	B	Will occur frequently in the life of the system.
Occasional	C	Will occur several times in the life of the system.
Remote	D	Unlikely, but can reasonably be expected to occur in the life of the system.
Improbable	E	Unlikely, but possible to occur in the life of the system.

Source: Program Manager for Chemical Demilitarization, *System Safety Management Plan for the Non-Stockpile Chemical Materiel Product*, August 2001

Table A-5. Risk Assessment Codes

Frequency of Occurrence	Consequence Category I Catastrophic	II Critical	III Marginal	IV Negligible
A - Frequent	1	1	1	3
B - Probable	1	1	2	3
C - Occasional	1	2	3	4
D - Remote	2	2	3	4
E - Improbable	3	3	3	4

Hazard Risk Index	Risk Assessment Code	Action Required
IA, IB, IC, IIA, IIB, IIIA	1	Unacceptable - immediate corrective action required. Asst. Sec. Army Decision.
ID, IIC, IID, IIIB	2	Undesirable - reduced priority, corrective action required. Product Manager for Non-Stockpile Chemical Materiel decision.
IE, IIE, IIIC, IIID, IIIE, IVA, IVB	3	Acceptable - low priority for corrective action (may not warrant action). System Safety Program Manager decision.
IVC, IVD, IVE	4	Acceptable - no corrective action required.

Source: Program Manager for Chemical Demilitarization, *System Safety Management Plan for the Non-Stockpile Chemical Materiel Product*, August 2001

4. TRANSPORTATION

Movement of the items from Igloo G to the EDS will be by truck. The transportation route is approximately 122 meters long. There will be a maximum of 15 trips to move all the munitions, one item at a time. The basic truck accident rate for a rural two-lane road is 2.19×10^{-6} accidents per mile (Harwood and Russell, 1990). This is further adjusted by a factor of 100 to 2.19×10^{-8} accidents per mile when safety precautions incorporated into CWM escort procedures are taken into account (for example, skilled driver, organizational emphasis on safety, and control of other traffic in the vicinity). Multiplying the adjusted accident rate times the distance traveled and the number of trips yields an accident probability of 2.5×10^{-8} accidents per mile for movement of all of the munitions from Igloo G to the EDS.

If the EDS is used to destroy and treat the seven DOT cylinders, the number of trips will increase to 22. This yields an accident probability of 3.7×10^{-8} accidents per mile for the movement of all items (munitions and DOT cylinders).

According to the SSMP (PMCD, 2001b), such an event is "improbable" (probability category E). Since a transportation accident could have catastrophic effects (severity category I), the resulting RAC is 3 (IE) for transportation hazard probability.

5. MAXIMUM CREDIBLE EVENT (MCE)

Army Regulation (AR) 385-61 defines an MCE as a worst-case accident scenario that results in the release of agent and that has a reasonable probability of occurrence. The MCE for this operation is an evaporative release of 2.6 pounds of GB from an M125 bomblet before it is secured inside the EDS.

Many of the hazards analyzed here relate to releases of CWM into the environment. The D2PC computer code[2] (Whitacre, et al., January 1987) was used to evaluate the consequences of evaporative agent release scenarios. D2PC is an atmospheric dispersion model that computes the rate of evaporation and dispersion of chemical warfare agents. Attachment A-2 shows the results computed by D2PC. For daytime releases, a reasonable worst-case wind speed of 1 meter per second and an atmospheric stability category of D were used. The no effects distance for an evaporative release of GB from an M125 bomblet is 1,566 meters. Table A-6 summarizes D2PC results.

6. EXPLOSIVE HAZARD DISTANCE

Explosive hazards include the fragmentation hazard and the blast hazard and are determined from quantity-distance (Q-D) tables in Department of the Army Pamphlet (DA Pam) 385-64. The combined net explosive weight (NEW) for the explosives contained in the item being treated and the donor explosives that will be used to operate the EDS is less than 1 pound. The total NEW of explosives onsite will be less than 5 pounds. Therefore, 5 pounds of NEW was used to determine blast and fragmentation distances. In accordance with table 5-1 in DA Pam 385-64 the inhabited building distance (IBD) is 1,250 feet.

7. MITIGATION OF HAZARDS

Table A-7 contains a summary of the handling, movement, and EDS operational events; possible incidents; and hazards associated with the incidents. In addition, the following paragraphs provide more specific information on how to mitigate hazards associated with handling, moving, destroying, and neutralizing CWM.

---

[2] D2PC is a U.S. Army-approved computer program that provides estimates of downwind chemical agent hazard distances.

Table A-6. Chemical Agent Hazard Distances for MCE[a]

			D2PC Results (meters)		
Munition Type	Chemical Agent Fill	Fill Weight (pounds)	1 Percent Lethality	No Deaths	No Effects
M125 bomblet	Sarin	2.6	181	243	1,566

Note:

[a] Results reported in this table were obtained from the D2PC chemical hazard prediction model. Inputs to the model included: location (Dugway Proving Ground), season (summer), munition type (4.2-inch mortar), agent type (mustard), release type (explosive), atmospheric stability class (class D). A complete printout of model inputs and outputs is located in attachment A-2 to annex A, Hazard Analysis.

Table A-7. Summary of Identified Hazards and Risk Assessment Codes

Item	Hazard	Uncontrolled RAC	Controlled RAC
Hazards During Handling			
001	Explosive rupture of a munition in the VCS	2	2
002	Dropping a munition or cylinder without an explosion in the VCS	2	3
003	Improper lifting	2	3
004	Crushing injuries	2	3
005	Pinching injuries	2	3
006	Tripping/falling injuries	2	3
007	Improper handling of decontaminants	2	3
008	Heat injuries	2	3
009	Cold injuries	2	3
Hazards During EDS Operations			
010	Decontamination solution exposure	2	3
011	Drum handling mishap	2	3
Transportation			
012	Vehicle accident	3	3

Notes:

The Program Manager for Chemical Demilitarization, *Phase 1 Unit 2, Hazard Tracking Log*, Final, September 2002, has captured system-specific hazards that are not repeated in this HA.

EDS = Explosive Destruction System
RAC = risk assessment code
VCS = Vapor Containment System

The location of the EDS site allows separation from public areas should an accident occur. The location is served by roads that allow response personnel access to the site.

An Emergency Medical Technician and ambulance will be on duty during chemical operations.

Two-way radio and cellular telephone communications are available in the event of an accident. The phones and/or radios used will be certified safe for operation around munitions.

Edgewood Chemical Biological Center (ECBC) personnel will perform monitoring of the EDS Vapor Containment System (VCS). Inspection of facilities and monitoring of the work environment will reduce the probability of leaks occurring and will preclude workers from entering an immediately dangerous to life and health contaminated area unknowingly.

When handling CWM, workers shall minimize the handling to reduce the likelihood of dropping. Workers should wear work gloves, safety shoes, and use proper lifting techniques and lifting mechanisms. Explosive Operators shall be trained in proper handling techniques and in the use of personal protective equipment (PPE).

Explosive Operators will conduct CWM handling. Explosive Operators are trained in handling armed and burstered chemical munitions and chemical-filled cylinders. The use of PPE will protect Explosive Operators from hazards resulting from release of agent. Radio communication is available in the event of an accident. The EDS will be positioned, within safety guidelines, close to the CWM storage location to minimize the distance Explosive Operators must move the munition.

Implementation of these mitigators can reduce both the severity and probability of hazards that can occur.

8. SUMMARY

An HA that encompasses the risk potential of handling, moving, and destroying CWM has been performed for the Destruction Plan. The proposed site for the EDS operations is acceptable. Hazards were identified from the concept of operations and from historical information, and RACs were assigned based on consequence severity and frequency of occurrence. There were 12 hazards identified. Eleven were assigned controlled RAC 3 and are acceptable with review. One was assigned a RAC 2. This hazard involves the remote chance of personnel dropping the munition during handling, resulting in a detonation. The PMNSCM has accepted this hazard.

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ATTACHMENT A-1
HAZARD CONTROL LOG WORKSHEETS

Table A-1-1. Assessment Plan Hazards

Item	Hazardous Condition	Cause	Effect	RAC	Recommendation	Resolution	Controlled RAC	Remarks
Hazards During Handling								
001	Explosive rupture of munition in the VCS	Munition may be dropped while being moved in the VCS or when removed from the PCC	Death or serious injury	2 (ID)	Only EOD trained personnel will handle the munition; all others will remain outside the hazardous fragmentation distance. Non-essential personnel will remain outside the 1 percent lethality distance. (Essential support personnel [e.g., first responders, select EDS operators, monitoring operators] may be outside the hazardous fragmentation distance but inside the 1 percent lethality distance.)	EOD trained personnel will do all of the handling. All other personnel will be evacuated from the area.	2 (1D)	Item 001 looks at a dropped munition and PCC unpacking hazard.

Table A-1-1. Assessment Plan Hazards (Continued)

Item	Hazardous Condition	Cause	Effect	RAC	Recommendation	Resolution	Controlled RAC	Remarks
002	Uncontrolled release of hazardous chemicals in the VCS	Dropping an item while unpacking without an explosion in the VCS	Exposure to chemical agent	2 (ID)	Train workers in proper use of mechanical lifting equipment and provide PPE.	Workers will be wearing Level C PPE when handling the item.	3 (IE)	
003	Personal injury	Improper lifting	Personal injury	2 (IID)	Train workers in proper lifting techniques; use mechanical lifting devices when possible.		3 (IIE)	
004	Personal injury	Crushing injury	Personal injury	2 (ID)	Do not lift more weight than is recommended by OSHA; Use proper lifting devices that are in good condition; Do not position body parts under heavy items.		3 (IE)	
005	Personal injury	Pinching injury	Personal injury	2 (IID)	Do not position body parts between items.		3 (IIE)	
006	Physical hazard	Tripping/falling	Personal injury	2 (IID)	Store overpacks properly. Remove tripping hazards from work areas.		3 (IIE)	

Table A-1-1. Assessment Plan Hazards (Continued)

Item	Hazardous Condition	Cause	Effect	RAC	Recommendation	Resolution	Controlled RAC	Remarks
007	Chemical injury	Improper handling of decontamination chemicals	Personal injury	2 (IID)	Train personnel in proper decontamination techniques and PPE selection.		3 (IIID)	
008	Physical injury	Heat injury	Personal injury	2 (IID)	Provide conditioned air for hot work environment. Train workers in injury prevention and recognition.		3 (IIID)	
009	Physical injury	Cold injury	Personal injury	2 (IID)	Provide heated spaces where workers can warm up. Train workers in injury prevention and recognition.		3 (IIID)	
Hazards During EDS Operations								
010	Chemical injury	Improper handling of decontamination chemicals during EDS neutralization	Personal injury	2 (IID)	Train personnel in proper mixing techniques and PPE selection.		3 (IIID)	
011	Personal injury	Improper lifting/movement of waste drums	Personal injury	2 (IID)	Train workers in proper lifting techniques; use mechanical lifting devices when possible.		3 (IIE)	

Table A-1-1. Assessment Plan Hazards (Continued)

Item	Hazardous Condition	Cause	Effect	RAC	Recommendation	Resolution	Controlled RAC	Remarks
Hazards During Transportation **(only include this section if item will be moved by vehicle)**								
012	Physical injury	Vehicle accident	Personal injury	3 (IE)	Follow chemical weapon escort procedures when transporting munition from storage bunker to EDS.		3 (IIE)	

Notes:

The Program Manager for Chemical Demilitarization, *Phase 1 Unit 2, Hazard Tracking Log*, Final, September 2002, has captured system-specific hazards that are not repeated in this HA.

EDS	=	Explosive Destruction System
EOD	=	explosive ordnance disposal
OSHA	=	Occupational Safety and Health Administration
PCC	=	propelling charge can
PPE	=	personal protective equipment
RAC	=	risk assessment code
VCS	=	Vapor Containment System

ATTACHMENT A-2
D2PC CALCULATION

ATTACHMENT A-2
D2PC CALCULATION

The following is a printout showing the inputs to the D2PC model used to estimate hazard distances for the Dugway Proving Ground Destruction Plan.

The following items were modeled:

- M125 bomblet with a sarin fill (evaporative release; maximum credible event)
- 4.2-inch mortar with a mustard agent fill (explosive release)
- M139 bomblet with a sarin fill (evaporative release)
- 105mm projectile with mustard agent fill (explosive release)
- 4.2-inch mortar with a mustard agent fill (evaporative release)
- DOT cylinder - 498 mL - HD (evaporative release).

DOWNWIND HAZARD PROGRAM D2PC

M125 BOMBLET WITH SARIN FILL – EVAPORATIVE RELEASE

TYPE ? FOR DEFINITIONS

1. YOUR NOVICE LEVEL: 3,2,1 OR 0 NOV
INPUT:1

2. LOCATION LOC
AAD,DPG,EWA,JHI,LBG,NAP,PBA,PAD,RMA,UAD,EUR,NDF
INPUT:DPG

3. SEASON SEA
WIN,SPR,SUM,FAL
INPUT:SUM

5. MUNITION TYPE MUN
105,155,8IN,500,750,M55,525,139,M23,4.2,TON,TMU,NON
INPUT:NON

6. AGENT TYPE AGN
GA,GB,GD,GF,VX,BZ,HY,UD,HD,H1,H3,HT,LL,AC,
CG,CK,DM,EG,QL,DF,DC,TC,PR,IP,ZS,KB,NA
INPUT:GB

8. RELEASE TYPE REL
INS,EVP,SEM,VAR,STK,STJ,FLS,FIR,IGL,EVS
INPUT:EVP

9. STABILITY TYPE STB

A,B,C,D,E,F,U,S,W

INPUT:D

10. WINDSPEED (M/SEC) WND

INPUT:1

BRT=25. DI= .5 6.0 10.0

7. SPILL OR AIRBORNE SOURCE (MG) QQQ

INPUT:LB 2.6

LB TO MG .118E+07

SURFACE

12. TEMPERATURE (DEG C) TMP

INPUT:35

17. SURFACE CODE SUR

GRA,CON,NDF

INPUT:CON

18. TIME OF EVAPORATION (MIN) TEV

INPUT:60

CON EVR=4.900E+03(MG/MIN-SQ M) AREA=1.427E+00(SQ M)

VPR=5.246E+00

Q=1.179E+06(MG) Q'=4.195E+05(MG) TEV=6.000E+01(MIN)

ALL OTHER INPUT

ALL

1 MUN:NON AGN:GB REL:EVP WND= 1.0(M/S) TMP=35.0(C) DPG-SUM

STB:D

```
  Q(MG)    TS(MIN)  HTS(M)   HML(M)   SXS(M)   SYS(M)   SZS(M)
4.195E+05 6.00E+01  .00E+00 2.00E+02 3.98E-01 3.98E-01 1.00E-01  D
```

W/2-MINUTE CORRECTION

181. (M) IS DISTANCE TO 1% LETHALITY

243. (M) IS DISTANCE TO NO DEATHS

W/O 2-MINUTE CORRECTION

1566. (M) IS DISTANCE TO NO EFFECTS

ALL OTHER INPUT

DOWNWIND HAZARD PROGRAM D2PC

4.2-INCH MORTAR WITH MUSTARD AGENT FILL – EXPLOSIVE RELEASE

```
 TYPE ? FOR DEFINITIONS

1. YOUR NOVICE LEVEL: 3,2,1 OR 0 NOV
INPUT:1

2. LOCATION              LOC
    AAD,DPG,EWA,JHI,LBG,NAP,PBA,PAD,RMA,UAD,EUR,NDF
INPUT:DPG

3. SEASON                SEA
    WIN,SPR,SUM,FAL
INPUT:SUM

5. MUNITION TYPE         MUN
    105,155,8IN,500,750,M55,525,139,M23,4.2,TON,TMU,NON
INPUT:4.2

6. AGENT TYPE            AGN
    GA,GB,GD,GF,VX,BZ,HY,UD,HD,H1,H3,HT,LL,AC,
    CG,CK,DM,EG,QL,DF,DC,TC,PR,IP,ZS,KB,NA
INPUT:HD

8. RELEASE TYPE          REL
    INS,EVP,SEM,VAR,STK,STJ,FLS,FIR,IGL,EVS
INPUT:INS
```

9. STABILITY TYPE STB

A,B,C,D,E,F,U,S,W

INPUT:D

10. WINDSPEED (M/SEC) WND

INPUT:1

BRT=25. DI= 2.0 100.0 150.0

SURFACE

12. TEMPERATURE (DEG C) TMP

INPUT:35

22. TIME AFTER FUNCTIONING (MIN) TIM

INPUT:60

ALL OTHER INPUT

ALL

1 MUN:4.2 AGN:HD REL:INS WND= 1.0(M/S) TMP=35.0(C) DPG-SUM

STB:D

Q(MG)	TS(MIN)	HTS(M)	HML(M)	SXS(M)	SYS(M)	SZS(M)	
1.421E+06	8.00E-02	.00E+00	2.00E+02	3.80E+00	3.80E+00	2.00E-01	D

52. (M) IS DISTANCE TO 1% LETHALITY

64. (M) IS DISTANCE TO NO DEATHS

349. (M) IS DISTANCE TO NO EFFECTS

ALL OTHER INPUT

DOWNWIND HAZARD PROGRAM D2PC

M139 BOMBLET WITH SARIN FILL – EVAPORATIVE RELEASE

TYPE ? FOR DEFINITIONS

1. YOUR NOVICE LEVEL: 3,2,1 OR 0 NOV
INPUT:1

2. LOCATION LOC
AAD,DPG,EWA,JHI,LBG,NAP,PBA,PAD,RMA,UAD,EUR,NDF
INPUT:DPG

3. SEASON SEA
WIN,SPR,SUM,FAL
INPUT:SUM

5. MUNITION TYPE MUN
105,155,8IN,500,750,M55,525,139,M23,4.2,TON,TMU,NON
INPUT:NON

6. AGENT TYPE AGN
GA,GB,GD,GF,VX,BZ,HY,UD,HD,H1,H3,HT,LL,AC,
CG,CK,DM,EG,QL,DF,DC,TC,PR,IP,ZS,KB,NA
INPUT:GB

8. RELEASE TYPE REL
INS,EVP,SEM,VAR,STK,STJ,FLS,FIR,IGL,EVS
INPUT:EVP

9. STABILITY TYPE STB

A,B,C,D,E,F,U,S,W

INPUT:D

10. WINDSPEED (M/SEC) WND

INPUT:1

BRT=25. DI= .5 6.0 10.0

7. SPILL OR AIRBORNE SOURCE (MG) QQQ

INPUT:KG .295

UNIT CODES

ATM=AT	SQ FT=SF	LB=LB	MB=MB	GAL=GL
BAR=BR	GM=GM	M=MT	OZ=OZ	L=LT
CM=CM	HR=HR	M/MIN=PM	SEC=SC	ML=ML
DEG F=DF	IN=IN	C M/MN=M3	TON(M)=TM	PT=PT
FT=FT	KT=KT	MI/HR=MH	TON=TN	QT=QT

7. SPILL OR AIRBORNE SOURCE (MG) QQQ

INPUT:295000

SURFACE

12. TEMPERATURE (DEG C) TMP

INPUT:35

17. SURFACE CODE SUR

GRA,CON,NDF

INPUT:CON

18. TIME OF EVAPORATION (MIN) TEV

INPUT:60

CON EVR=5.628E+03(MG/MIN-SQ M) AREA=3.570E-01(SQ M)

VPR=5.246E+00

Q=2.950E+05(MG) Q'=1.205E+05(MG) TEV=6.000E+01(MIN)

ALL OTHER INPUT

ALL

1 MUN:NON AGN:GB REL:EVP WND= 1.0(M/S) TMP=35.0(C) DPG-SUM STB:D

Q(MG)	TS(MIN)	HTS(M)	HML(M)	SXS(M)	SYS(M)	SZS(M)	
1.205E+05	6.00E+01	.00E+00	2.00E+02	1.99E-01	1.99E-01	1.00E-01	D

W/2-MINUTE CORRECTION

89. (M) IS DISTANCE TO 1% LETHALITY

119. (M) IS DISTANCE TO NO DEATHS

W/O 2-MINUTE CORRECTION

768. (M) IS DISTANCE TO NO EFFECTS

ALL OTHER INPUT

DOWNWIND HAZARD PROGRAM D2PC

105MM PROJECTILE WITH MUSTARD FILL – EXPLOSIVE RELEASE

TYPE ? FOR DEFINITIONS

1. YOUR NOVICE LEVEL: 3,2,1 OR 0 NOV
INPUT:1

2. LOCATION LOC
AAD,DPG,EWA,JHI,LBG,NAP,PBA,PAD,RMA,UAD,EUR,NDF
INPUT:DPG

3. SEASON SEA
WIN,SPR,SUM,FAL
INPUT:SUM

5. MUNITION TYPE MUN
105,155,8IN,500,750,M55,525,139,M23,4.2,TON,TMU,NON
INPUT:105

6. AGENT TYPE AGN
GA,GB,GD,GF,VX,BZ,HY,UD,HD,H1,H3,HT,LL,AC,
CG,CK,DM,EG,QL,DF,DC,TC,PR,IP,ZS,KB,NA
INPUT:HD

8. RELEASE TYPE REL
INS,EVP,SEM,VAR,STK,STJ,FLS,FIR,IGL,EVS
INPUT:INS

9. STABILITY TYPE STB

A,B,C,D,E,F,U,S,W

INPUT:D

10. WINDSPEED (M/SEC) WND

INPUT:1

BRT=25. DI= 2.0 100.0 150.0

SURFACE

12. TEMPERATURE (DEG C) TMP

INPUT:35

22. TIME AFTER FUNCTIONING (MIN) TIM

INPUT:60

ALL OTHER INPUT

ALL

1 MUN:105 AGN:HD REL:INS WND= 1.0(M/S) TMP=35.0(C) DPG-SUM

STB:D

Q(MG)	TS(MIN)	HTS(M)	HML(M)	SXS(M)	SYS(M)	SZS(M)	
7.053E+05	8.00E-02	.00E+00	2.00E+02	3.80E+00	3.80E+00	2.00E-01	D

35. (M) IS DISTANCE TO 1% LETHALITY

44. (M) IS DISTANCE TO NO DEATHS

264. (M) IS DISTANCE TO NO EFFECTS

ALL OTHER INPUT

DOWNWIND HAZARD PROGRAM D2PC

4.2-INCH MORTAR WITH MUSTARD FILL – EVAPORATIVE RELEASE

TYPE ? FOR DEFINITIONS

1. YOUR NOVICE LEVEL: 3,2,1 OR 0 NOV
INPUT:1

2. LOCATION LOC
AAD,DPG,EWA,JHI,LBG,NAP,PBA,PAD,RMA,UAD,EUR,NDF
INPUT:DPG

3. SEASON SEA
WIN,SPR,SUM,FAL
INPUT:SUM

5. MUNITION TYPE MUN
105,155,8IN,500,750,M55,525,139,M23,4.2,TON,TMU,NON
INPUT:4.2

6. AGENT TYPE AGN
GA,GB,GD,GF,VX,BZ,HY,UD,HD,H1,H3,HT,LL,AC,
CG,CK,DM,EG,QL,DF,DC,TC,PR,IP,ZS,KB,NA
INPUT:HD

8. RELEASE TYPE REL
INS,EVP,SEM,VAR,STK,STJ,FLS,FIR,IGL,EVS
INPUT:EVP

9. STABILITY TYPE STB

A,B,C,D,E,F,U,S,W

INPUT:D

10. WINDSPEED (M/SEC) WND

INPUT:1

BRT=25. DI= 2.0 100.0 150.0

SURFACE

12. TEMPERATURE (DEG C) TMP

INPUT:35

17. SURFACE CODE SUR

GRA,CON,NDF

INPUT:CON

18. TIME OF EVAPORATION (MIN) TEV

INPUT:60

CON EVR=2.320E+02(MG/MIN-SQ M) AREA=3.291E+00(SQ M)

VPR=2.391E-01

Q=2.720E+06(MG) Q'=4.580E+04(MG) TEV=6.000E+01(MIN)

ALL OTHER INPUT

ALL

1 MUN:4.2 AGN:HD REL:EVP WND= 1.0(M/S) TMP=35.0(C) DPG-SUM

STB:D

Q(MG)	TS(MIN)	HTS(M)	HML(M)	SXS(M)	SYS(M)	SZS(M)	
4.580E+04	6.00E+01	.00E+00	2.00E+02	6.05E-01	6.05E-01	1.00E-01	D

14. (M) IS DISTANCE TO 1% LETHALITY

18. (M) IS DISTANCE TO NO DEATHS

197. (M) IS DISTANCE TO NO EFFECTS

ALL OTHER INPUT

DOWNWIND HAZARD PROGRAM D2PC
DOT CYLINDER 498ML HD

TYPE ? FOR DEFINITIONS

1. YOUR NOVICE LEVEL: 3,2,1 OR 0 NOV
INPUT:1

2. LOCATION LOC
AAD,DPG,EWA,JHI,LBG,NAP,PBA,PAD,RMA,UAD,EUR,NDF
INPUT:DPG

3. SEASON SEA
WIN,SPR,SUM,FAL
INPUT:SUM

5. MUNITION TYPE MUN
105,155,8IN,500,750,M55,525,139,M23,4.2,TON,TMU,NON
INPUT:NON

6. AGENT TYPE AGN
GA,GB,GD,GF,VX,BZ,HY,UD,HD,H1,H3,HT,LL,AC,
CG,CK,DM,EG,QL,DF,DC,TC,PR,IP,ZS,KB,NA
INPUT:HD

8. RELEASE TYPE REL
INS,EVP,SEM,VAR,STK,STJ,FLS,FIR,IGL,EVS
INPUT:EVP

9. STABILITY TYPE STB

A,B,C,D,E,F,U,S,W

INPUT:D

10. WINDSPEED (M/SEC) WND

INPUT:1

BRT=25. DI= 2.0 100.0 150.0

7. SPILL OR AIRBORNE SOURCE (MG) QQQ

INPUT:ML 498

ML TO MG .631E+06

SURFACE

12. TEMPERATURE (DEG C) TMP

INPUT:35

17. SURFACE CODE SUR

GRA,CON,NDF

INPUT:CON

18. TIME OF EVAPORATION (MIN) TEV

INPUT:60

CON EVR=2.684E+02(MG/MIN-SQ M) AREA=7.641E-01(SQ M) VPR=2.391E-01

Q=6.315E+05(MG) Q'=1.231E+04(MG) TEV=6.000E+01(MIN)

ALL OTHER INPUT

ALL

1 MUN:NON AGN:HD REL:EVP WND= 1.0(M/S) TMP=35.0(C) DPG-SUM STB:D

Q(MG)	TS(MIN)	HTS(M)	HML(M)	SXS(M)	SYS(M)	SZS(M)	
1.231E+04	6.00E+01	.00E+00	2.00E+02	2.91E-01	2.91E-01	1.00E-01	D

5. (M) IS DISTANCE TO 1% LETHALITY

8. (M) IS DISTANCE TO NO DEATHS

93. (M) IS DISTANCE TO NO EFFECTS

ALL OTHER INPUT

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ANNEX B

MUNITIONS SPECIFICATIONS

ANNEX B
MUNITIONS SPECIFICATIONS

This annex contains excerpts from the *Old Chemical Weapons Reference Guide* (SciTech, 1998) describing the components of the munitions to be destroyed using the Explosive Destruction System. The information provided is to allow readers who are unfamiliar with the munitions to gain an appreciation for the items that will be destroyed. Since the actual items being destroyed are range-recovered items, they may be covered in corrosion or otherwise damaged from having been fired and/or exposed to the elements for numerous years. The following munitions are included:

- 4.2-inch Mortar
- 105mm Projectile
- M139 Bomblet
- M125 Bomblet.

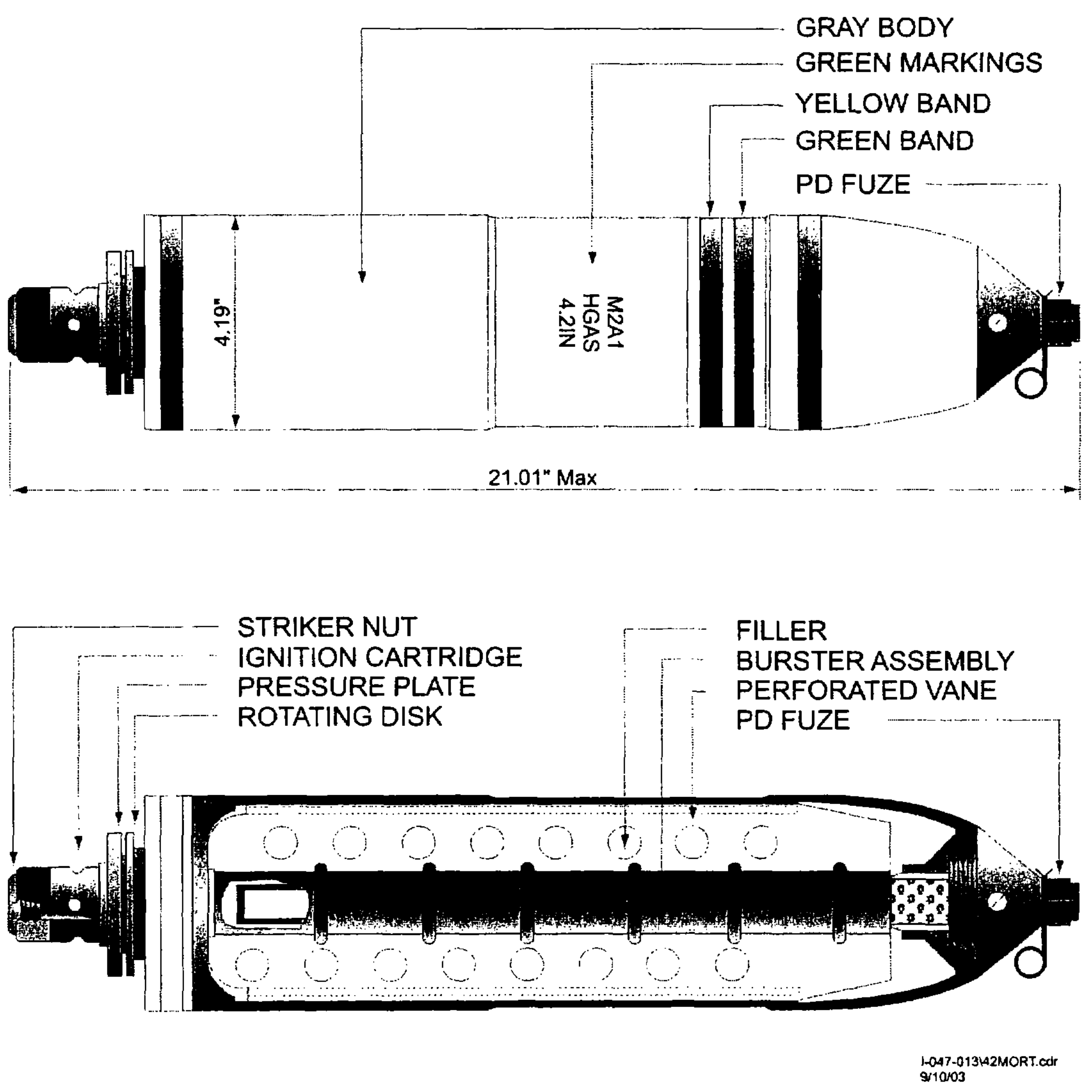

Figure B-1. 4.2-inch Mortar

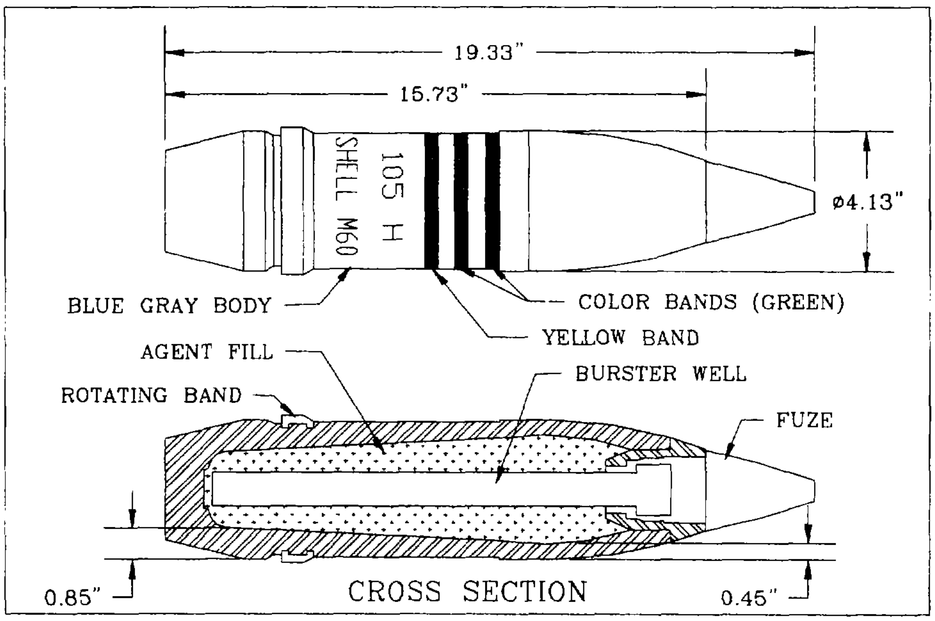

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Figure B-2. Projectile, 105mm Gas Persistent H/HD, M60

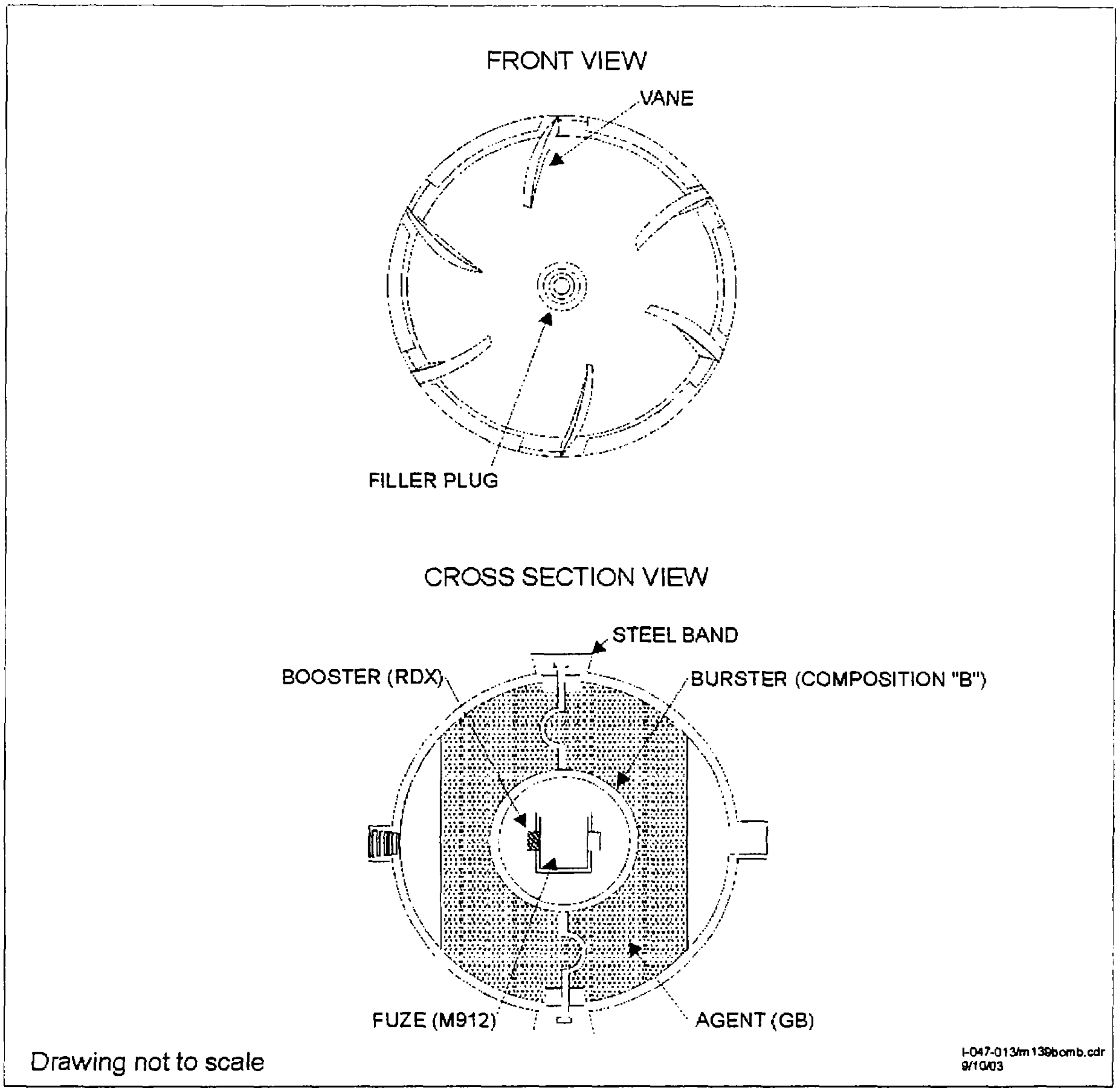

Figure B-3. Chemical Bomblet, M139

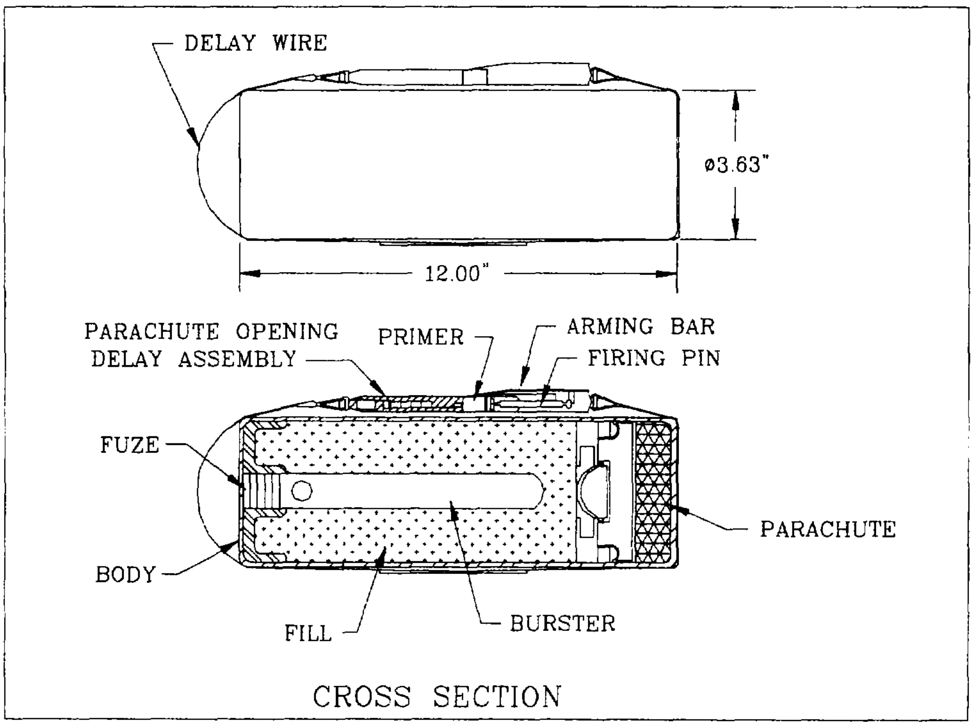

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Figure B-4. Cluster Bomb, Gas (GB), 10-Pound, M125, M125A1

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ANNEX C
PHYSICAL AND CHEMICAL PROPERTIES

ANNEX C

PHYSICAL AND CHEMICAL PROPERTIES

Table C-1 lists the physical and chemical properties of the chemical warfare materiel that will be treated in the Explosive Destruction System (EDS). The chemicals include:

- Mustard agent (H), distilled mustard agent (HD), and mustard-T agent (HT)
- Sarin (GB).

Table C-1. Chemical and Physical Properties of Chemical Agents of Concern

Chemical Name	Levinstein Mustard (H) 70% bis (2-Chloroethyl) sulfide 30% Higher Molecular Weight Polysulfides	Distilled Mustard (HD) Diethyl, 2,2-dichloride sulfide [bis(2-Chloroethyl) sulfide]	Mustard-T (HT) 60% HD, 40% [2(2-Chloroethylthio)ethyl] ether (T)
Short Name	Levinstein Mustard (H)	Distilled Mustard (HD)	Mustard-T (HT)
Chemical Formula	C4H8Cl2S	C4H8Cl2S	HD - $C_4H_8Cl_2S$ T - $C_8H_{16}Cl_2OS_2$
Molecular Weight	159.08 (pure mustard)	159.08	HD - 159.08 T - 263.3
Physical State	Amber to brown oily liquid	Pale yellow oily liquid	Viscous liquid, clear to pale yellow
Vapor Density (relative to air)	Generally exceeds 5.5	5.5	6.92
Liquid Density	1.27 g/mL at 25°C	1.27 g/mL at 25°C	1.269 g/mL at 25°C
Solid Density	N/A	Crystal, 1.37 g/cm^3 at 0°C	N/A
Normal Freezing Point	8°C	14.45°C	0 to 1.3°C for 60/40 mixture
Boiling Point	Decomposes at about 180°C	217°C extrapolated	>228°C, not constant. H fraction removed by distillation
Vapor Pressure	Impurities tend to lower vapor pressure below 0.11 mm Hg	0.11 mm Hg at 25°C	0.104 mm Hg at 25°C
Volatility	Approximately 920 mg/m^3 at 25°C (reported for HD)	610 mg/m^3 at 20°C 920 mg/m^3 at 25°C	831 mg/m^3 at 25°C
Viscosity	3.95 centistokes at 25°C (HD)	3.95 centistokes at 25°C	6.05 centistokes at 20°C
Solubility	0.092 g/100 g H_2O at 22°C. Completely soluble in acetone, CCl4, CH_3Cl tetrachloroethane, ethyl benzoate, and ether. Completely soluble in 92.5% ethanol above 28.6°C.	0.092 g/100 g H_2O at 22°C. Completely soluble in acetone, CCl_4, CH_3Cl tetrachloroethane, ethyl benzoate, and ether. Completely soluble in 92.5% ethanol above 28.6°C.	Practically insoluble in water. Soluble in most organic solvents.
Heat of Combustion	4,500 cal/g	756.03 kcal/mole	5,240 cal/g for 20-year old samples

Table C-1. Chemical and Physical Properties of Chemical Agents of Concern (Continued)

Chemical Name	Levinstein Mustard (H) 70% bis (2-Chloroethyl) sulfide 30% Higher Molecular Weight Polysulfides	Distilled Mustard (HD) Diethyl, 2,2-dichloride sulfide [bis(2-Chloroethyl) sulfide]	Mustard-T (HT) 60% HD, 40% [2(2-Chloroethylthio)ethyl] ether (T)
Latent Heat of Vaporization	94 cal/g	94 cal/g	No data. HD is more volatile than T. It boils off and the combustion of the mixture changes.
Latent Heat of Fusion	26.5 cal/g	26.5 cal/g	N/A
Special Properties			Decomposes at 165°C and 185°C
Flash Point	105°C	105°C (Can be ignited by large explosive charges)	About 100°C
DOT Classification	Poison A	Poison A	Poison A
Corrosivity	Brass rapidly corroded. Cast iron poor	Brass rapidly corroded at 65°C; 0.0001 inch/month at 65°C on steel	Pressure develops in steel
Decontaminants	Bleaching powder, sodium hypochlorite	Bleaching powder, sodium hypochlorite, fire	Bleach
Stabilizers Commonly Used	Can be stabilized with acridine or naphthoquinoline	Can be stabilized with acridine or naphthoquinoline	N/A

Notes:

cal/g	=	calorie per gram
DOT	=	Department of Transportation
g	=	gram
g/cm^3	=	gram per cubic centimeter
g/mL	=	gram per milliliter
kcal	=	kilocalorie
mg/m^3	=	milligram per cubic meter
mm Hg	=	millimeters of mercury
N/A	=	not available

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ANNEX D
ACRONYMS/ABBREVIATIONS

ANNEX D

ACRONYMS/ABBREVIATIONS

AED	atomic emission detector
AEL	airborne exposure limit
amp	ampere
AR	Army Regulation
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CASARM	Chemical Agent Standard Analytical Reference Material
CCTV	closed-circuit television
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CMA	U.S. Army Chemical Materials Agency
COC	chain of custody
coliwasa	composite liquid waste sampler
CSC	conical-shaped charge
CWC	Chemical Weapons Convention
CWM	chemical warfare materiel
DA	Department of the Army
DA Pam	Department of the Army Pamphlet
DAAMS	Depot Area Air Monitoring System
DDESB	Department of Defense Explosives Safety Board
DHHS	Department of Health and Human Services
DoD	Department of Defense
DOT	Department of Transportation

DPG	Dugway Proving Ground
DQO	data quality objective
DSHW	Division of Solid and Hazardous Waste
ECBC	Edgewood Chemical Biological Center
EDS	Explosive Destruction System
EOD	explosive ordnance disposal
EPDM	ethylene propylene diene monomer
ET	Escort Team
FM	Field Manual
FPD	flame photometric detector
FSS	Fragment Suppression System
GB	sarin
GC	gas chromatograph
H	mustard agent
HA	hazard analysis
HASP	Health and Safety Plan
HD	mustard agent, distilled
HEPA	high efficiency particulate air
HT	mustard-T mixture
HTL	Host Team Leader
IBD	inhabited building distance
ICAM	improved chemical agent monitor
ID	identification
IITRI	IIT Research Institute
IOP	Internal Operating Procedure
IT	inspection team

kVA	kilovolt ampere
kW	kilowatt
LC/MS	liquid chromatography/mass spectrometry
LCO	limiting condition of operation
LSC	linear-shaped charge
µL	microliter
µsec	microsecond
MARB	Materiel Assessment Review Board
MCE	maximum credible event
MDL	method detection limit
MEA	monoethanolamine
mm	millimeter
MMD-1	Munitions Management Device, Version 1
MRC	multiple round container
MS	mass spectrometer
MSD	mass selective detector
MSDS	material safety data sheet
NEMA	National Electrical Manufacturer's Association
NEW	net explosive weight
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NMR	nuclear magnetic resonance
NOSE	No Significant Effects
NRT	near real-time
NSCMP	Non-Stockpile Chemical Materiel Product
O&M	operations and maintenance
OPCW	Organisation for the Prohibition of Chemical Weapons

P1U3	Phase 1 Unit 3
PAO	Public Affairs Office
PC	personal computer
PCC	propelling charge can
PCT	preconcentrator tube
PDS	Personnel Decontamination Station
PM ECW	Program Manager for the Elimination of Chemical Weapons
PMCD	Program Manager for Chemical Demilitarization
PMNSCM	Product Manager for Non-Stockpile Chemical Materiel
POIO	Public Outreach and Information Office
PPE	personal protective equipment
psi	pounds per square inch
psig	pounds per square inch gauge
Q-D	quantity-distance
QA	quality assurance
QA/QC	quality assurance/quality control
QAPjP	Quality Assurance Project Plan
QC	quality control
QL	quality laboratory
QP	quality plant
RAC	risk assessment code
RCRA	Resource Conservation and Recovery Act
RDX	cyclonite
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SD	standard deviation
SMP	Site Monitoring Plan
SOP	Standing Operating Procedure
SP	Sampling Plan

SS	stainless steel
SSHO	Site Safety and Health Officer
SSMP	System Safety Management Plan
TCD	thermal conductivity detector
TCLP	Toxicity Characteristic Leaching Procedure
TEU	U.S. Army Technical Escort Unit
TNT	trinitrotoluene
TS	Technical Secretariat
TSDF	treatment, storage, and disposal facility
TWA	time-weighted average
UBC	Uniform Building Code
UDEQ	Utah Department of Environmental Quality
UL	Underwriters Laboratory
USEPA	U.S. Environmental Protection Agency
V	volt
VCS	Vapor Containment System
XSD	halogen selective detector

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ANNEX E

CWC REQUIREMENTS

ANNEX E

CWC REQUIREMENTS

This annex contains an Explosive Destruction System (EDS) operations scenario from the Chemical Weapons Convention (CWC) perspective. Specific CWC checkpoints are identified. These checkpoints must be observed to ensure compliance with CWC requirements.

These checkpoints must be observed for all CWC declarable items which may include munitions or Department of Transportation cylinders.

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EDS Operational Scenario with CWC Checkpoints

1. First-Day EDS Operations

1.1 Receipt of chemical warfare materiel (CWM) at EDS:

a. Treaty Compliance Officer provides the Organisation for the Prohibition of Chemical Weapons (OPCW) inspection team (IT) with a minimum 4-hour notification prior to movement for transfer of the CWM from storage to destruction facility.

b. EDS System Manager notifies Host Team Leader (HTL) of arrival of CWM from storage to destruction. IT is present to observe the arrival of the CWM near the entrance of the Vapor Containment System (VCS).

1.2 Verification of CWM:

a. The IT is allowed to verify the exterior markings on the CWM overpack (item number and OPCW tag number, if present).

b. The U.S. Escort Team (ET) will take instamatic pictures of any **OPCW tagged CWM** before the item is moved into the VCS.

c. Instamatic pictures must be approved by the HTL before the CWM overpack is taken into the VCS.

1.3 Destruction of CWM:

a. The EDS System Manager ensures that the closed-circuit television (CCTV) camera is adjusted so that the IT can see the CWM:

- Enter the VCS
- Being monitored
- Unpacked
- Prepared for destruction
- Placed in the chamber and door closed.

b. The EDS System Manager will take a digital camera picture of the CWM after it is placed into the Fragment Suppression System on the loading table. The digital photos should include a placard with the munitions identification number and date of destruction. The EDS System Manager will furnish a hard copy of the pictures to the HTL.

c. Ten minutes before detonation of the CWM, the EDS System Manager will inform the HTL of the approximate time that detonation will occur.

d. After detonation, the EDS System Manager will notify the HTL of the time that destruction took place.

1.4 Verification of Destruction:

a. EDS System Manager notifies the HTL when 2-hour sample collection is taken. EDS System Manager will furnish the HTL with a copy of the sample analysis report as soon as it becomes available.

b. EDS System Manager notifies the HTL when 4-hour sample collection is taken. EDS System Manager will furnish the HTL with a copy of the sample analysis report as soon as it becomes available.

c. EDS System Manager notifies the HTL when containment vessel is drained into waste collection drum.

d. EDS System Manager notifies the HTL when all personnel have left the VCS for the day. The IT and the ET will proceed to the VCS to place OPCW seals on all three doors to the VCS. **NOTE:** No further entrance can be made into the VCS without coordination with the HTL except in emergencies. If the seal is broken due to an emergency, the EDS System Manager will notify the HTL at the earliest immediate opportunity.

2. Second-Day EDS Operations (Verification of Destruction Continued)

a. At approximately 0700 hrs, the IT and Escorts, will remove the seals on the VCS doors.

b. An Escort will attend the daily safety briefing and in turn, brief the IT and the ET.

c. The EDS System Manager will provide the HTL with a 10-minute notice before the sample from the waste collection drum is taken.

d. The HTL will furnish the IT with an empty sample container. The IT will place a seal on the container for ID purposes. The IT will give this container and two to four unused seals to the EDS System Manager directly or through the HTL to the EDS System Manager. The EDS System Manager will use one seal to seal the sample container, one seal to seal the overpack, and may use one seal to seal the drum after the drum is closed.

e. The IT will observe sample collection and overpacking via CCTV.

f. The EDS System Manager will ensure that all other operations in the VCS are halted and that the appropriate command post personnel and cameras are dedicated to the sampling operation. While maintaining telephone communication with the HTL, the EDS System Manager will ensure that the following operations are conducted within view of the CCTV cameras:

- Hold the container up, long enough to see the container seal as clearly as possible.

- Demonstrate the sample container is empty before collection of the sample, by inverting the open container in view of the CCTV.

- Collect the sample from the waste collection drum.

- Cover sample with its lid and place one of the seals over the opening of the lid.

- Overpack the sample container as appropriate and apply another seal over the opening of the overpack.

- Seal the waste collection drum with another seal, and zoom the camera on the seal long enough to confirm the seal number as well as possible (if required).

- Bring the overpacked sample outside for the IT and ET to confirm seal integrity, note the seal number, and return any unused seals.

- Prepare and transport the overpacked sample to the lab.

g. The EDS System Manager notifies the HTL of when the sample container is to be analyzed in the lab in plenty of time for the IT to be present to observe the analytical process if they so choose. **NOTE:** The seals placed on the overpack and sample container cannot be broken without inspector presence or permission of the HTL.

h. The EDS System Manager will take digital pictures of the munitions fragments as they are removed from the vessel and furnish a hard copy of the pictures to the HTL. Each photo will have a placard containing the munition identification number and date the item was destroyed.

i. **NOTE:** Waste collection drums will remain in the VCS until the IT has verified that the contents are below the agreed end-point of destruction as indicated by the HTL or unless the IT has provided and witnessed the removal of the seal on the drum. Waste containers or the VCS must be sealed with an OPCW seal if destruction of the waste collection drum sample has not been confirmed and the drum is left overnight.

j. The mutilated metal parts will remain onsite until the inspectors have confirmed that they are satisfied with the CCTV and photographic record of their destruction, and the HTL confirms that the metal parts can be removed.

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ANNEX F

SITE-SPECIFIC MONITORING PLAN FOR THE EXPLOSIVE DESTRUCTION SYSTEM AT DUGWAY PROVING GROUND

ANNEX F
SITE-SPECIFIC MONITORING PLAN FOR THE EXPLOSIVE DESTRUCTION SYSTEM AT DUGWAY PROVING GROUND

1. INTRODUCTION

This annex presents an Air Monitoring Plan for use with the Explosive Destruction System (EDS) at Dugway Proving Ground (DPG), Utah.

1.1 Purpose

The purpose of this Plan is to illustrate the strategy that will be used to monitor airborne concentrations of the chemical warfare materiel (CWM), mustard (HD), and sarin (GB), during operation of the EDS. This Plan is based on the *EDS Phase 1 Unit 2 Deployment Monitoring Concept Plan* (PMCD, 2003) and incorporates guidance from Department of the Army Pamphlet (DA Pam) 385-61.

1.2 Scope

This Plan establishes objectives, procedures, and responsibilities for air monitoring during destruction of recovered chemical warfare materiel at DPG using the EDS. It describes the monitoring strategy rationale for general area air monitoring and choice of monitoring equipment.

A baseline will be conducted to identify monitoring alarm interferences and to establish achievable monitoring levels for EDS operations at DPG.

1.3 Objectives

The objectives of the plan are as follows:

- Illustrate the monitoring method used for the CWM operations performed by the EDS

- Ensure that workers and public safety and health are maintained by providing adequate environmental monitoring as specified in Army Regulation (AR) 385-61.

2. RESPONSIBILITIES

The Product Manager for Non-Stockpile Chemical Materiel (PMNSCM), through its EDS crew (Edgewood Chemical Biological Center [ECBC]), will do the following:

- Collect and retain all agent-related air monitoring data generated during this project.

- Provide guidance on monitoring operations conducted onsite.

- Provide equipment and training and certified personnel to operate monitoring equipment and maintain certification data.

- Provide training and certified personnel to set up and calibrate monitoring equipment and collect monitoring samples from general area monitoring stations.

3. MONITORING

The purpose of air monitoring is to indicate to workers when a hazardous atmosphere is present, maintain a record of worker exposure to chemical agent vapors, and warn of potential releases of chemical agent into the environment, such as during an accident or spill, thus promoting the safety of the operators, the environment, and the public. The choice of monitoring equipment is based on the type of monitoring to be performed and the types of chemicals involved. The location of monitors or sample ports is based on the operation, the airflow in the area, and the location of the source of the compounds of interest. Figure F-1 contains the estimated configuration of the Vapor Containment System (VCS) work site.

Monitoring at the site is described in the Site Safety Submission.

3.1 Terms

3.1.1 Airborne Exposure Limit (AEL). The AEL is the maximum allowable concentration in the air for occupational exposures to any CWM. AELs for chemical agents are contained in AR 385-61. Unless otherwise noted, AEL in this document refers to the 8-hour time-weighted average (TWA) for unmasked chemical agent workers.

3.1.2 Area Monitoring. Area monitoring provides notification to personnel when there is a problem and action must be taken. The monitoring devices or sampling ports are placed in locations within the work area where there is a potential for encountering hazardous vapors. The sample locations are determined based on such factors as the chemical involved, the airflow pattern in the area, the operation(s) being performed, and the location of the source of potential chemical of concern release.

3.1.3 Confirmation. Confirmation of MINICAMS® alarms is accomplished by the use of the Depot Area Air Monitoring System (DAAMS). DAAMS is an air sampling system that consists of a portable air-sampling unit and a mobile- or laboratory-based analytical system. The air sampling unit is designed to draw a controlled volume of air through a collection material. As the air passes through the sorbent tube, agent is collected on the collection material. Sampling is conducted for a predetermined period of time at a predetermined flow rate. DAAMS tubes collected at the EDS site will be taken to the

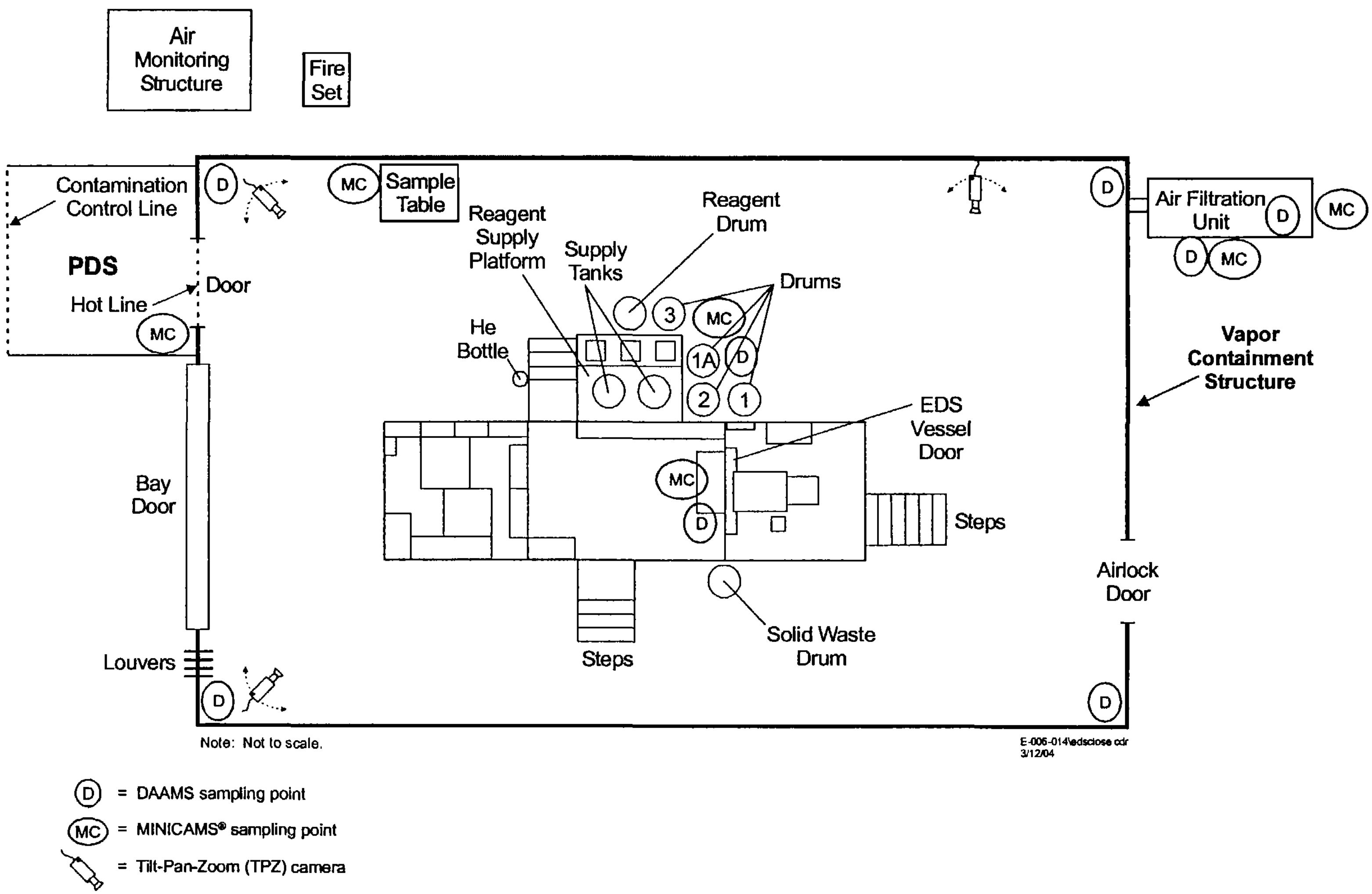

Figure F-1. VCS Configuration

ECBC mobile chemical laboratory for analysis on a gas chromatograph/mass spectrometer (GC/MS). Sample analysis takes approximately 1 hour.

3.1.4 Internal Operating Procedures (IOPs). An IOP is a previously approved document containing monitoring and analysis procedures used by ECBC.

3.1.5 Low-Level Alarm. A low-level alarm is a device used in conjunction with a low-level monitor or detector that produces an audible sound and flashing light when concentration of a particular contaminant is detected at or above the AEL.

3.1.6 Low-Level Detector. A low-level detector is a detection device that can provide detection capability for concentration at or below the established AEL for a particular contaminant. MINICAMS is an example of a low-level detector.

3.1.7 MINICAMS. MINICAMS is an automatic air monitoring system that collects compounds on a solid sorbent trap, thermally desorbs them into a capillary gas chromatograph (GC) column for separation, and detects the compounds with a halogen selective detector (XSD) or a flame photometric detector (FPD). The MINICAMS is a lightweight, portable, low-level monitor designed to respond in less than 10 minutes with alarm capability.

3.1.8 Near Real-Time (NRT) Monitoring. Monitoring where analytical results are available in a short time (less than 15 minutes).

3.1.9 Quality Plant (QP) Sample. A QP sample is a quality control (QC) sample that demonstrates whether the instrument is performing within the pre-defined limits.

3.1.10 TWA. TWA is the maximum allowable concentration in the air for occupational exposures of any CWM in any 8-hour work shift within a 40-hour workweek. Detection above the 1.0 TWA level requires workers to don personal protective equipment (PPE) or leave the work site.

3.1.11 Improved Chemical Agent Monitor (ICAM). The ICAM is a hand-held gross level detector used for routine monitoring at the Personnel Decontamination Station (PDS). The ICAM detects vapors of chemical agents by sensing molecular ions of specific mobilities and uses timing and microprocessor techniques to reject interferences.

3.1.12 Gross-Level Detector. A gross-level detector is a detection device that can provide a response within 3 minutes for high agent concentrations (above the AEL).

3.2 Types of Monitoring

3.2.1 NRT Monitoring. ECBC will perform NRT monitoring at DPG in support of the EDS. The primary monitoring instrument used will be the MINICAMS for detection of HD and GB.

Work performed within the VCS will be monitored. MINICAMS sampling lines will be located at the personnel enter/exit door, over the EDS vessel door, over the sample table, and over the waste drums. In addition, the VCS filter system will have monitoring ports at mid-bed and stack locations. The NRT monitor will be set to monitor the mid-bed location and stack location.

There will also be a MINICAMS available for use in the PDS in the event of a potentially exposed worker.

3.2.2 Confirmation and Historical. DAAMS tubes will be placed at each MINICAMS position and in the four corners of the VCS. Whenever an NRT alarm occurs, the DAAMS tubes will be collected and analyzed to determine if the NRT alarm was a true positive. In addition, DAAMS are collected during the EDS operation even when there has not been an NRT alarm. These DAAMS tubes, not associated with an NRT alarm, are considered "historical."

3.3 Monitoring Procedures

The following paragraphs describe monitoring and analytical procedures. Table F-1 summarizes VCS monitoring procedures.

3.3.1 NRT Monitoring.

3.3.1.1 NRT Monitoring System. NRT air monitoring will be accomplished using MINICAMS set at an alarm point no greater than 0.7 times the TWA level for HD and GB (see table F-1).

The MINICAMS consists of a monitor (sample collection, analysis, detection, and alarm equipment), a vacuum pump, heated sample transfer lines, compressed gases, and a computer. In the sampling cycle, the vacuum pump draws air into the MINICAMS system through the heated sample transfer line. The air sample is drawn through an automated GC that first collects the sample on a solid sorbent (or in a specific volume sample loop) and then thermally desorbs the agent into a separation column for analysis. The MINICAMS will be configured with the appropriate detector for the chemical of concern it is set up to monitor. Appropriate action will be taken to correct any malfunctions.

3.3.1.2 NRT Data Evaluation. The performance of the MINICAMS is monitored daily. Each day a QP challenge is performed using standards of known concentration. The area, peak height, retention time, peak width and injection size, and the name of the technician are recorded on a log sheet.

3.3.1.3 NRT Data Notifications. The MINICAMS operator will notify the EDS System Manager and Crew Chief in the event of any MINICAMS alarm. In addition, the DPG Site Safety and Health Officer (SSHO) may be notified, depending on the situation. Table F-2 lists several possible situations, persons to be notified, and possible actions to be taken.

Table F-1. VCS Monitoring Matrix

	MINICAMS® (Near Real-Time)	DAAMS Tube Samplers (General Area/Confirmation)
Locations	• VCS filtration system • VCS work table[a] • EDS vessel door • EDS waste drum[a] • PDS • Air filtration mid-bed • Air filtration stack	Collocated with each MINICAMS (except in the EDS) and at the four corners of the VCS
Sampling Frequency	Continuous	Up to 12 hours
Instrument Analysis Time	10 minutes or less	Approximately 15 minutes[b]
Number of Personnel	1 MINICAMS operator	1 GC/MS operator and sample technician
Target Agents	Mustard (as HD) Sarin (GB)	Mustard (as HD) Sarin (GB)
Workplace Exposure Level (8-hour TWA)[c]	HD – 0.003 mg/m^3 GB – 0.0001 mg/m^3	HD – 0.003 mg/m^3 GB – 0.0001 mg/m^3
Alarm Setpoint (not to exceed)	HD – 0.0021 mg/m^3 GB – 0.00007 mg/m^3	Not applicable
Challenge Levels	HD – 0.003 mg/m^3 and 0.0006 mg/m^3 GB – 0.0001 mg/m^3 and 0.00002 mg/m^3	HD – 0.003 mg/m^3 and 0.0006 mg/m^3 GB – 0.0001 mg/m^3 and 0.00002 mg/m^3

Notes:

[a] The VCS worktable and waste drums are monitored by a common MINICAMS.
[b] This 15 minutes does not include the time needed to transport the DAAMS tube samples from the sampling site to the laboratory.
[c] The Division of Solid and Hazardous Waste (DSHW) uses the term chemical control limit (CCL), which is equivalent to 8-hour TWA.

DAAMS = Depot Area Air Monitoring System
EDS = Explosive Destruction System
GB = sarin
GC/MS = gas chromatograph/mass spectrometer
HD = distilled mustard
mg/m^3 = milligrams per cubic meter
PDS = Personnel Decontamination Station
TWA = time-weighted average
VCS = Vapor Containment System

Table F-2. NRT Notification Matrix

Situation	Notification	Possible Action[a]
Single MINICAMS® Alarm	• EDS System Manager and EDS Crew Chief	• Await result of next MINICAMS cycle • Evacuate non-essential personnel • Evaluate PPE • Analyze DAAMS tubes
Two Consecutive MINICAMS Alarms	• EDS System Manager and EDS Crew Chief • DPG Safety	• Await result of next MINICAMS cycle • Evaluate PPE • Determine source of contamination
Three Consecutive MINICAMS Alarms	• EDS System Manager and EDS Crew Chief • DPG Safety	• Determine source of contamination • Relocate filtration system MINICAMS sample point from midbed location to post-bed location (if alarm was on the midbed MINICAMS)

Notes:

[a] This table is based on detection of chemical warfare materiel (CWM) at the alarm setpoint. Decision on actual actions taken will reside with the EDS System Manager. Actions may vary, depending on the actual concentration of CWM detected.

DAAMS = Depot Area Air Monitoring System
DPG = Dugway Proving Ground
EDS = Explosive Destruction System
PPE = personal protective equipment

3.3.1.4 NRT Control Samples. A QP challenge will be injected at the end of the heated sample line of the MINICAMS using standard solutions of chemical agents at concentrations prescribed in the IOP.

3.3.1.5 Challenge Log Sheet. All challenges of the chemical agent monitors will be recorded on an agent challenge log sheet.

3.3.2 Confirmation and Historical Monitoring. The DAAMS will be used for confirmation and historical monitoring.

3.3.2.1 Confirmation and Historical Monitoring System. The DAAMS is an air sampling and analysis method that provides surveillance sampling data by using sorbent tubes. The system consists of small, sorbent-packed glass tubes, a vacuum pump, and flow control hardware. In the DAAMS method, air is drawn through the sorbent tube at a constant flow rate for a predetermined length of time. The contaminant adsorbs onto the tube packing. After sample collection, the tubes are taken to a laboratory facility where the sample is analyzed by GC/MS.

3.3.2.2 Confirmation and Historical Data Evaluation. The performance of the GC/MS used to analyze the DAAMS tube samples is monitored daily in accordance with the ECBC Quality Control Plan and ECBC IOPs.

3.3.2.3 Confirmation and Historical Data Notifications. The support laboratory will notify the EDS System Manager of the results of all DAAMS tube analyses. If the samples were confirmation samples, the EDS System Manager will notify the DPG SSHO of the results. If the samples were analyzed only for historical purposes, the EDS System Manager will notify the DPG SSHO only if agent was detected. The PMNSCM EDS System Manager will be notified of all detections and confirmed detections of chemical agent. Table F-3 is the DAAMS tube analysis matrix.

3.3.2.4 Confirmation and Historical Control Samples. The support laboratory will perform QC in accordance with its written laboratory QC Plan.

3.3.3 Monitoring of Potentially Exposed Workers. Monitoring of potentially exposed workers will be conducted in accordance with interim guidance provided by the Office of the Assistant Secretary of the Army, dated 10 June 2003.

3.4 Records

Monitoring Branch technicians will maintain records of MINICAMS analyses, the flow calibrations, and challenges of the MINICAMS. Monitoring Branch personnel will be responsible for certifying that monitoring operations are conducted according to this

Table F-3. DAAMS Tube Analysis Matrix

Response To	Location/Scenario	DAAMS Tube Analysis Sites
MINICAMS® Alarm	VCS	All DAAMS stations in VCS and VCS exhaust filtration system
MINICAMS Alarm	Midbed carbon filter position in VCS air handling unit	All DAAMS stations in VCS and VCS exhaust filtration system
Contingency	Munition detonation inside VCS (outside of EDS vessel)	All DAAMS stations in VCS and VCS exhaust filtration system
Contingency	Visually observe item leaking inside VCS (outside of EDS vessel)	All DAAMS stations in VCS and VCS exhaust filtration system
Contingency	Failure of engineering controls in VCS	All DAAMS stations in VCS and VCS exhaust filtration system
Quality Assurance Requirement		Each day of destruction operations at least one – • DAAMS tube from above the door of the EDS vessel

Notes:

DAAMS = Depot Area Air Monitoring System
EDS = Explosive Destruction System
VCS = Vapor Containment System

plan and the site-specific QC procedures. ECBC will provide all monitoring data to the EDS System Manager.

3.5 QC

All monitoring operations will be conducted in accordance with the ECBC Monitoring Branch's Quality Control Plan and IOP. ECBC will incorporate the data generated into the Monitoring Branch 40-year data storage program, should access to additional information be required. QC requirements for applicable ECBC IOPs (IOP MT-08, IOP MT-13, and IOP MT-16) can be found in tables F-4, F-5, and F-6.

Table F-4. Quality Control Requirements for IOP MT-08[a]

QC Sample	Frequency	Acceptance Limits	Corrective Action
Mass Spectrometer Tuning Verification	Not less than every 12 hours during sample analysis	Relatives abundances in accordance with table F-5, IOP MT-08	Retune. Verify tuning before continuing.
Five Point Initial Calibration (ICAL)	When instrument parameters change After preparation of new standards When ICV or CCV fails	R2 ≥0.99	Investigate and correct the cause. Repeat ICAL.
Initial Calibration Verification (ICV) – at Mid-range	At the start of each day of analysis After ICAL	Each target analyte ±20% of true value (VX and L: 25%)	Recalibrate.
Continuing Calibration Verification (CCV) – at Mid-range	At the end of a sample run or every 12 hours, whichever is shorter	Each target analyte ±20% of true value (VX and L: 25%)	If result >120% of true value, recalibrate. Sample results may be reported. If result <80% of true value, recalibrate. Reanalyze sample extracts for each sample analyzed since the last passing CCV.
Method Blank: For HD: 90% Clean MEA For GB: 60% Clean Ethanolamine Hydrochoride	1 per batch of 20 or fewer samples	Target analytes less than reporting limit	Reanalyze all samples associated with unacceptable blank.
Laboratory Control Spike (LCS) (Using Sample Matrix as for Method Blank) – Spike Target Analytes	1 per batch of 20 or fewer samples	Recovery within control limits shown in table F-8 for individual agents	Reanalyze sample to verify validity of spiking solution; if same results, flag data. If spike results differ, reanalyze all associated field samples (including new extraction).

Table F-4. Quality Control Requirements for IOP MT-08[a] (Continued)

QC Sample	Frequency	Acceptance Limits	Corrective Action
Laboratory Control Spike Duplicate (LCSD) (Using Sample Matrix as for Method Blank) – Spike Target Analytes	1 per batch of 20 or fewer samples	Recovery within control limits shown in table F-8 for individual agents Relative percent difference (RPD) between LCS and LCSD within control limits shown in Table F-8 for individual agents	If recovery outside limits, corrective action same as LCS. If RPD outside limits, reanalyze sample and duplicate; if still outside control limit, flag associated data.
Matrix Spike/Matrix Spike Duplicate (MS/MSD) (Using Client Sample, if Specified)	1 each per batch of 20 or fewer samples	Same as LCS and LCSD – except that limits are only advisory	Reanalyze MS/MSD, verify spiking solutions. If results are confirmed, flag spiked sample.

Notes:

[a] Analysis of Chemical Warfare Agents in Extracts Using a GC/MS System

MS/MSD may be specified by client. If no MS/MSD is specified, analyst shall select a sample for matrix spiking.

Reanalysis indicates starting with a new aliquot of sample and performing all sample preparation and analysis steps, including new QC samples and adherence to calibration requirements.

GB = sarin
HD = distilled mustard
IOP = Internal Operating Procedure
QC = quality control

Table F-5. Quality Control Requirements for IOP MT-16[a]

QC Sample	Frequency	Acceptance Limits	Corrective Action
Sampling flow rate measurements	During calibration	HD: 400 ±50 mL/min GB: 600 to 1,000 mL/min	Adjust and recheck before starting calibration and analysis.
Initial Calibration (ICAL) 1 High-level Challenge (1.0 TWA) 1 Low-level Challenge (0.25 TWA)	Start of each operational day or after failing mid-day challenge	High: 0.75 to 1.25 TWA Low: 0.125 to 0.375 TWA	Investigate and correct cause. Repeat ICAL.
Initial Calibration Verification (ICV) – Also called Challenge 1 High-level Challenge (1.0 TWA) 1 Low-level Challenge (0.25 TWA)	After ICAL	High: 0.75 to 1.25 TWA Low: 0.125 to 0.375 TWA	Investigate and correct cause. Repeat ICAL.
Continuing Calibration Verification (CCV) – Also Called Challenge 1 Low-level Challenge (0.25 TWA)	After every 4 to 5 hours of operation and at the end of operational day	Low: 0.125 to 0.375 TWA	Investigate and correct cause. Repeat ICAL if failure is for mid-day challenge. No action if failure is at the end of the day. Note on data forms.

Notes:

[a] Operation and Maintenance Procedures for MINICAMS® Mounted in a Mobile Vehicle

Method is for one-of-a-kind, near real-time samples. Reanalysis not possible for QC failures.

mL/min = milliliter per minute
QC = quality control
TWA = time-weighted average

Table F-6. Quality Control Requirements for IOP MT-13[a]

QC Sample	Frequency	Acceptance Limits	Corrective Action
Sampling Flow Rate Measurements	Before and after sample collection	Starting and ending flow rates within 10% of the average flow rate	Repeat sampling unless samples are one of a kind. If one of a kind, flag data.
Five Point Initial Calibration (ICAL)	When instrument parameters change After preparation of new standards When ICV or CCV fails	R2 ≥0.99	Investigate and correct the cause. Repeat ICAL.
Initial Calibration Verification (ICV)	At the start of each day of analysis After ICAL	Each target analyte ±15% of true value	Recalibrate.
Continuing Calibration Verification (CCV)	At the end of a sample run or every 12 hours, whichever is shorter	Each target analyte ±15% of true value	If result >115% of true value, recalibrate. Sample results may be reported. If result <85% of true value, recalibrate. Analyze second sample tube for each sample analyzed since the last passing CCV.
Method Blank	At least one before analyzing samples	Absence of target analytes and interferences	Investigate and correct. Repeat method blank to verify acceptable performance.
Quality Process (QP) – Similar to Matrix Spike	1 each per batch of 20 or fewer samples	Recovery ≥10% (Note: Agent-specific limits are currently under development.)	Verify spiking solutions. Analyze second QP tube. If results are confirmed, spike and analyze second sample tube from location where QP was taken. Ensure acceptance limits met. Flag data.

Notes:

[a] Analysis of Chemical Warfare Agents and Degradation Products on DAAMS Tubes using a Gas Chromatography System Coupled with a Mass Selective Detector

QC = quality control

3.5.1 Quality Control of DAAMS Tubes. New DAAMS tubes shall be subjected to the following tests, or the manufacturer shall supply documentation with each lot purchased, attesting that the lot of DAAMS tubes has been subjected to these tests and meets all requirements. The number of tubes to be pulled for testing is found in table F-7.

Sampling/acceptance and inspection requirements consist of the following:

- Sample number is in accordance with ANSI/ASQC Z1.4, AQL of 2.5 percent nonconformance.
- Visual inspection for loose packing, warped tube ends, and loose sorbent material

Table F-7. Samples Sizes for Normal Inspection for Maximum of 2.5 Percent Non-Conformance

Lot or Batch Size	General Inspection Level 1, Number of Samples	Rejection Number[a]
2 to 8	2	1
9 to 15	2	1
16 to 25	3	1
26 to 50	5	1
51 to 90	5	1
91 to 150	8	1
151 to 280	13	2
281 to 500	20	2
501 to 1,200	32	3

Note:

[a] Reject the entire lot if this number of samples is found to be defective.

- Pressure-drop test to ensure sufficient airflow through the tube. For each type of tube listed, the pressure drop may not exceed the value listed.

  - DAAMS 6mm tube Chromosorb® 106 — 15 inches Hg
  - DAAMS 6mm tube Tenax TA — 15 inches Hg
  - DAAMS 8mm tube Chromosorb 106 — 8.0 inches Hg
  - DAAMS 8mm tube Tenax TA — 8.0 inches Hg
  - DAAMS 15mm tube HayeSep® D — 15 inches Hg
  - Transfer tube Chromosorb 106 — 4.5 inches Hg
  - Transfer tube Tenax TA — 7.0 inches Hg.

3.5.2 Tube Conditioning. After the representative tubes from a lot pass visual inspection and pressure drop testing, they will be conditioned in a flow of nitrogen at 290°C for 20 minutes, followed by a 5-minute cooling period. All tubes must be conditioned before agent recovery testing.

3.5.3 Agent Recovery Testing. Agent recovery testing ensures that the DAAMS sampling tubes can adsorb and desorb sufficient analyte for accurate sampling and analysis. The analyst performing recovery tests will enter his/her name and date on the appropriate line of the DAAMS Tube Acceptance Testing Form (MBFORM-51).

DAAMS tubes will be prepared according to the instructions in IOP-13 for GC/FPD quality laboratory (QL) samples. However, rather than a 3 microliter (µL) spike, each tube will be spiked at one TWA for GB (4 µL spike of standard solution). The spiked tubes will be analyzed for GB according to IOP-13, including instrument calibration and data reporting. The results of agent recovery testing will be recorded on the DAAMS Tube Acceptance Testing Form (MBFORM-51). In accordance with Chemical Agent Standard Analytical Reference Material (CASARM) requirements, recovery must be at least 75 percent to be acceptable. After the final test, the analyst/tester will sign the Acceptance Testing Form (MBFORM-51) to indicate whether the lot passes or fails the series of tests and deliver the form to the Chief of the Monitoring Branch.

If a sufficient number of tubes pass agent recovery testing, the remaining tubes in the lot will be conditioned and delivered to the Chief of the Monitoring Branch for issuance to samplers and analysts.

If more than the allowable number of tubes fail the agent recovery test, the lot is rejected. The analyst should return the entire lot to the QA representative. In consultation with the Chief of the Monitoring Branch, the QA representative will determine if each tube in the lot should be tested. If so, new paperwork will be prepared and sent to the analyst.

4. LIMITING CONDITIONS OF OPERATION (LCOs)

Chemical agent operations at the EDS will not be conducted unless LCOs are met. LCOs for air monitoring are shown in table F-8.

5. DATA QUALITY OBJECTIVES

The data quality objectives for the chemical compounds monitored at DPG during EDS operations can be found in table F-9.

Table F-8. LCOs (Monitoring)

Personnel	Calibration and QC	Instrumentation	Support Laboratory
1 Certified MINICAMS® operator	Agent calibration and challenge standards are current	Sufficient MINICAMS to monitor designated NRT monitoring points	Meets the laboratory's LCOs.
1 Certified GC/MS operator	Operational instruments calibrated and in control	Sufficient DAAMS sample tubes to monitor all sampling points (four locations in VCS, one in PDS, one in VCS filtration unit)	
1 Sample Technician	Operational method in control (QP samples)	Sufficient operational support equipment to support all monitors and monitoring locations	
EDS System Manager or designee present			

Notes:

DAAMS = Depot Area Air Monitoring System
EDS = Explosive Destruction System
GC/MS = gas chromatograph/mass spectrometer
LCOs = limiting conditions of operation
NRT = near real-time
PDS = Personnel Decontamination Station
QC = quality control
QP = quality plant
VCS = Vapor Containment System

Table F-9. Laboratory Data Quality Objectives for Agent Analysis Methods

Parameter	Matrix	Sample Collection Method	Lab Analytical Method	Reporting Units	Monitoring Level	Precision (RSD)	Accuracy (% Recovery)	Completeness (%)
GB	Air	MINICAMS® NRT	IOP MT-16	TWA	1.0 TWA	N/A[a]	75 to 125	95
		Historical DAAMS	IOP MT-13	TWA (mg/m^3)	1.0 TWA	N/A[a]	>10%[b]	95
		Confirmation DAAMS	IOP MT-13	TWA (mg/m^3)	1.0 TWA	N/A	Positive Response	95
	45% MEA	Grab	IOP MT-08	ppb (μg/L)	410[c]	≤30%[d]	54% to 111%[d]	95
HD	Air	MINICAMS NRT	IOP MT-16	TWA	1.0 TWA	N/A(1)	75 to 125	95
		Historical DAAMS	IOP MT-13	TWA (mg/m^3)	1.0 TWA	N/A(1)	>10%[b]	95
		Confirmation DAAMS	IOP MT-13	TWA (mg/m^3)	1.0 TWA	N/A	Positive Response	95
	90% MEA	Grab	IOP MT-08	ppb (μg/L)	290[e]	≤20%[f]	15% to 82%[f]	95

Notes:

a QP samples for MINICAMS and DAAMS methods are not analyzed in duplicate. Descriptive statistics for precision are not available.

b QP accuracy limit is currently under evaluation. Agent-specific limits will replace the temporary limit shown here when sufficient data are accumulated.

c Reported monitoring level is the Practical Quantitation Level (PQL) as determined from applying the 40 CFR 136, Appendix B Method Detection Limit (MDL) statistics to data obtained during the method validation study as reported in "Trace Determination of Isopropyl Methylphosphonofluoridate (GB) and Bis (2-Chloroethyl) Sulfide (HD) in Chemical Neutralization Solutions by Gas Chromatography-Mass Spectrometry," by Stuff, Cheicante, Morrissey, and Durst in J. Microcolumn Separations, 12(2) 87-92 (2000). MDL and PQL results generated by the ECBC Monitoring Laboratory will replace these values, when available.

Table F-9. Laboratory Data Quality Objectives for Agent Analysis Methods (Continued)

Notes: (Continued)

[d] Reported precision and accuracy are based on data obtained during the method validation study as reported in "Trace Determination of Isopropyl Methylphosphonofluoridate (GB) and Bis (2-Chloroethyl) Sulfide (HD) in Chemical Neutralization Solutions by Gas Chromatography-Mass Spectrometry," by Stuff, Cheicante, Morrissey, and Durst in J. Microcolumn Separations, 12(2) 87-92 (2000). Precision and accuracy values generated by the ECBC Monitoring Laboratory will replace these values, when available.

[e] For HD by IOP MT-08 method (monoethanolamine [MEA] grab samples), the monitoring level is reported as the PQL as determined from an MDL study according to 40 CFR 136, Appendix B. This study is being repeated and the results will supplant the value shown.

[f] For HD by IOP MT-08 method, the precision and accuracy are based on statistical description of method performance as determined from control chart data.

DAAMS	=	Depot Area Air Monitoring System
GB	=	sarin
HD	=	distilled mustard
IOP	=	Internal Operating Procedure
MEA	=	monoethanolamine
mg/m^3	=	milligrams per cubic meter
N/A	=	not applicable
NRT	=	near real-time
ppb	=	parts per billion
RSD	=	relative standard deviation
TWA	=	time-weighted average

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ANNEX G
DA HAZARD ANALYSIS

ANNEX G
DA HAZARD ANALYSIS

1. DESTRUCTION PLAN ANALYSIS METHODS

The Explosive Destruction System (EDS) will be used to dispose of suspect chemical agent-filled munitions at Dugway Proving Ground (DPG). Hazards associated with moving the recovered munitions (one at a time[1]), overpacked in propelling charge cans (PCCs), to the EDS have been identified in this attachment. This hazard analysis (HA) was performed in accordance with Army Regulation (AR) 385-61, *The Army Chemical Agent Safety Program*, and is intended to address the hazards that the Technical Escort Unit/Explosive Ordnance Disposal (TEU/EOD) personnel are exposed to while the items intended for destruction are outside the EDS system. To aid in evaluating identified hazards, potential incident and accident scenarios have been defined and risk assessment codes (RACs) assigned. The RACs are based on the combination of hazard severity and hazard frequency categories. Definitions of the hazard severities and hazard frequencies are listed in tables G-1 and G-2, respectively, and the RAC matrix is shown in table G-3. HA worksheets were used to record identified hazards and to propose recommendations and solutions (table G-4). Postulated accident scenarios associated with the identified hazards, the controls currently in place to mitigate each hazard, and recommendations for reducing the severity or likelihood of the scenario (and hence, the RAC) are described in the worksheets. Accident scenarios assigned RAC Extremely High require corrective action prior to operations. Accident scenarios assigned RAC High also require corrective action but are of lower priority than RAC Extremely High scenarios. If resolutions do not lower the RAC to Medium or Low, RAC Extremely High and High accident scenarios must be formally accepted by the responsible authorities.

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1 The plan is to process each item separately. It is possible that more than one item may be processed at a time if the fills of the items are the same and the quantity of explosives placed in the EDS do not exceed the design limitation. Should approvals be obtained to process more than one item at a time, the EDS System Manager will make the decision whether to proceed one item at a time.

Table G-1. Hazard Severity Categories

Catastrophic	I	Fatalities or serious injuries, loss of the facility, environmental release
Critical	II	Single fatality or serious injury, major facility damage, agent release within the facility
Moderate	III	Minor injury, minor equipment damage, agent release within engineering controls
Negligible	IV	No injuries, no equipment damage, no agent release

Table G-2. Hazard Frequency Categories

Frequent	A	Occurs often in facility or equipment service life
Likely	B	Occurs several times in facility or equipment service life
Occasional	C	Occurs infrequently/sporadically or some time in facility or equipment service life
Seldom	D	Possible but unlikely or remote chance of occurrence in facility or equipment service life
Unlikely	E	Not expected to occur in career/equipment service life

Table G-3. Decision Authority Matrix

			HAZARD PROBABILITY				
			Frequent	Likely	Occasional	Seldom	Unlikely
			A	B	C	D	E
HAZARD SEVERITY	Catastrophic	I	**EXTREMELY**				
	Critical	II	**HIGH**				
	Moderate	III		**MEDIUM**			
	Negligible	IV			**LOW**		

01-078-027; DAM.ppt 9/26/01

Source: Army Regulation 385-61, *The Army Chemical Agent Safety Program*, 12 October 2001.

Decision Authority:	Extremely High	Commanding General (CG), U.S. Army Materiel Command (AMC)
	High	CG, U.S. Army Chemical Materials Agency (CMA)
	Medium	Installation Commander/Tech Director
	Low	Installation Commander/Tech Director

Table G-4. Hazards Matrix

Item	Hazardous Condition	Cause	Effect	RAC	Recommendation	Resolution	Controlled RAC	Remarks
001	Rupture of munition	Munition may be dropped while being removed from an overpack	Exposure to chemical agent	High (ID)	Wear PPE when handling munitions; all persons without PPE will remain outside computed hazard zone.	Explosive Operators will wear Level C PPE.	Low (IIID)	
002	Explosion	Dropping an armed munition when handling or during movement to the EDS	Personal injury or death; agent release	High (ID)	Follow established handling procedures and minimize handling. Only EOD trained personnel will handle the munition; all others will remain outside the hazardous fragmentation distance. Non-essential personnel will remain outside the 1 percent lethality distance. (Essential support personnel [e.g., first responders, select EDS operators, monitoring operators] may be outside the hazardous fragmentation distance but inside the 1 percent lethality distance.)		High (ID)	This hazard will be mitigated after the munition is placed in the EDS vessel.

Table G-4. Hazards Matrix (Continued)

Item	Hazardous Condition	Cause	Effect	RAC	Recommendation	Resolution	Controlled RAC	Remarks
003	Uncontrolled release of hazardous chemicals	Overpack is not sealed properly or is not vapor tight during movement to the EDS	Slow leak of chemical agent vapor if CWM was broken during movement	Medium (IIIC)	Monitor to detect low-level leaks.		Low (IIID)	Monitoring will occur before moving munition to the EDS.
004	Personal injury	Improper lifting	Personal injury	Medium (IID)	Train workers in proper lifting techniques; use mechanical lifting devices when possible.		Low (IIE)	
005	Personal injury	Crushing injury; includes dropping a PCC while moving it	Personal injury	High (ID)	Do not lift more weight than is recommended by OSHA; Use proper lifting devices that are in good condition; Do not position body parts under heavy items.		Low (IIE)	
006	Personal injury	Pinching injury; includes dropping a PCC while moving it	Personal injury	Medium (IID)	Do not position body parts between items.		Low (IIE)	

Table G-4. Hazards Matrix (Continued)

Item	Hazardous Condition	Cause	Effect	RAC	Recommendation	Resolution	Controlled RAC	Remarks
007	Physical hazard	Tripping/falling	Personal injury	Medium (IID)	Keep walkways and work areas free of unnecessary obstacles; If path for moving munition from storage area to EDS is rutted, use dirt, crushed stone, or bridging to improve walkway.		Low (IIE)	
008	Chemical injury	Improper handling of decontamination chemicals	Personal injury	Medium (IID)	Train personnel in proper mixing techniques and PPE selection.		Low (IIID)	
009	Physical injury	Heat injury	Personal injury	Medium (IID)	Provide conditioned air for hot work environment. Train workers in injury prevention and recognition.		Low (IIID)	
010	Physical injury	Vehicle accident	Personal injury	Medium (IE)	Follow chemical weapon escort procedures when transporting munition from storage bunker to EDS.		Medium (IE)	

Table G-4. Hazards Matrix (Continued)

Notes:

CWM	=	chemical warfare materiel
EDS	=	Explosive Destruction System
EOD	=	explosive ordnance disposal
OSHA	=	Occupational Safety and Health Administration
PCC	=	propelling charge can
PPE	=	personal protective equipment
RAC	=	risk assessment code

2. DETERMINATION OF SEVERITY CATEGORIES

The severity of occurrence was determined qualitatively and was based on the analyst's judgment. Physical injuries were rated and based on capability for death (catastrophic), permanent injury (critical), minor injury (moderate), and injury not requiring medical treatment (negligible). Severity of system damage was rated catastrophic if total loss of the system would be expected.

3. FINDINGS

Ten hazards were identified, of which eight were assigned controlled RACs of Low and one a controlled RAC of medium. One hazard was assigned a controlled RAC High. Hazard 002 is an explosion hazard from the accidental dropping of the armed/fuzed munition while moving it from its storage location to the EDS. This would result in a potentially fatal or serious injury and is assessed an initial RAC of ID (High). The controlled RAC also was assigned ID (High). This conservative RAC was assigned because the EOD personnel will not be able to protect themselves from the forces of an explosion.

Severe damage of the facility was judged critical. Equipment damage that could be readily repaired was rated moderate. Negligible damage was considered damage that would not impair the system or damage that required replacement of an item normally expected to be replaced during routine maintenance.

4. DETERMINATION OF LIKELIHOOD CATEGORIES

The frequency of occurrence was judged qualitatively. Frequencies were assigned based upon the likelihood of occurrence during normal operations. Any routine operation that did not have controls designed or warnings present as part of the operation was judged probable. Any hazard that would occur continually was judged frequent.